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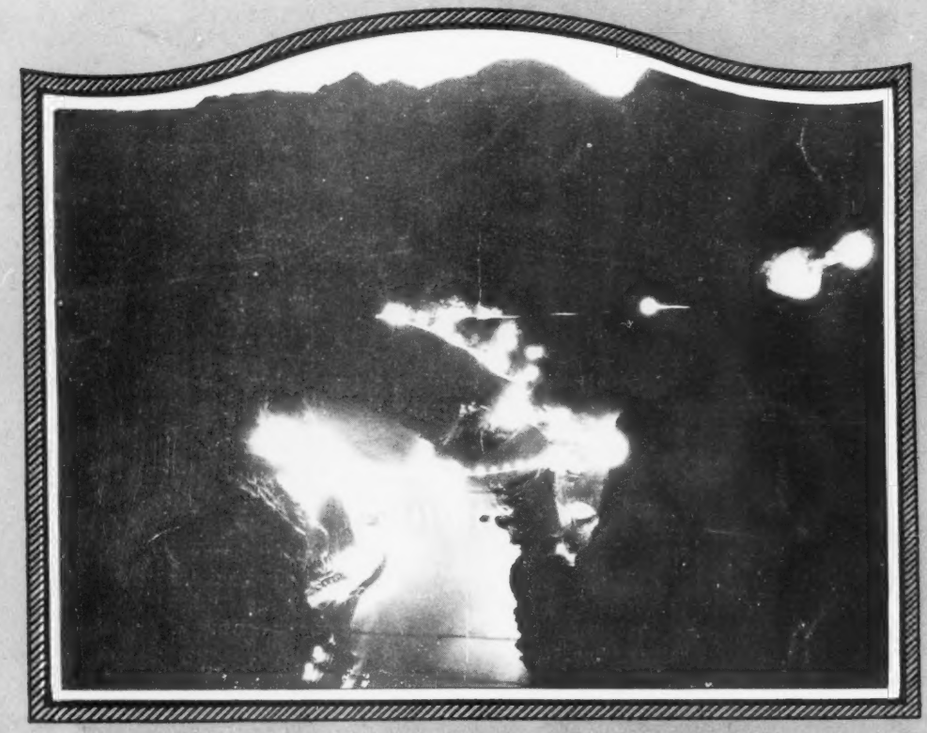

WHEN the shades of night fall in Black Canyon, the Hoover Dam site becomes a fairyland of incandescence so that men may work around the hands of the clock.

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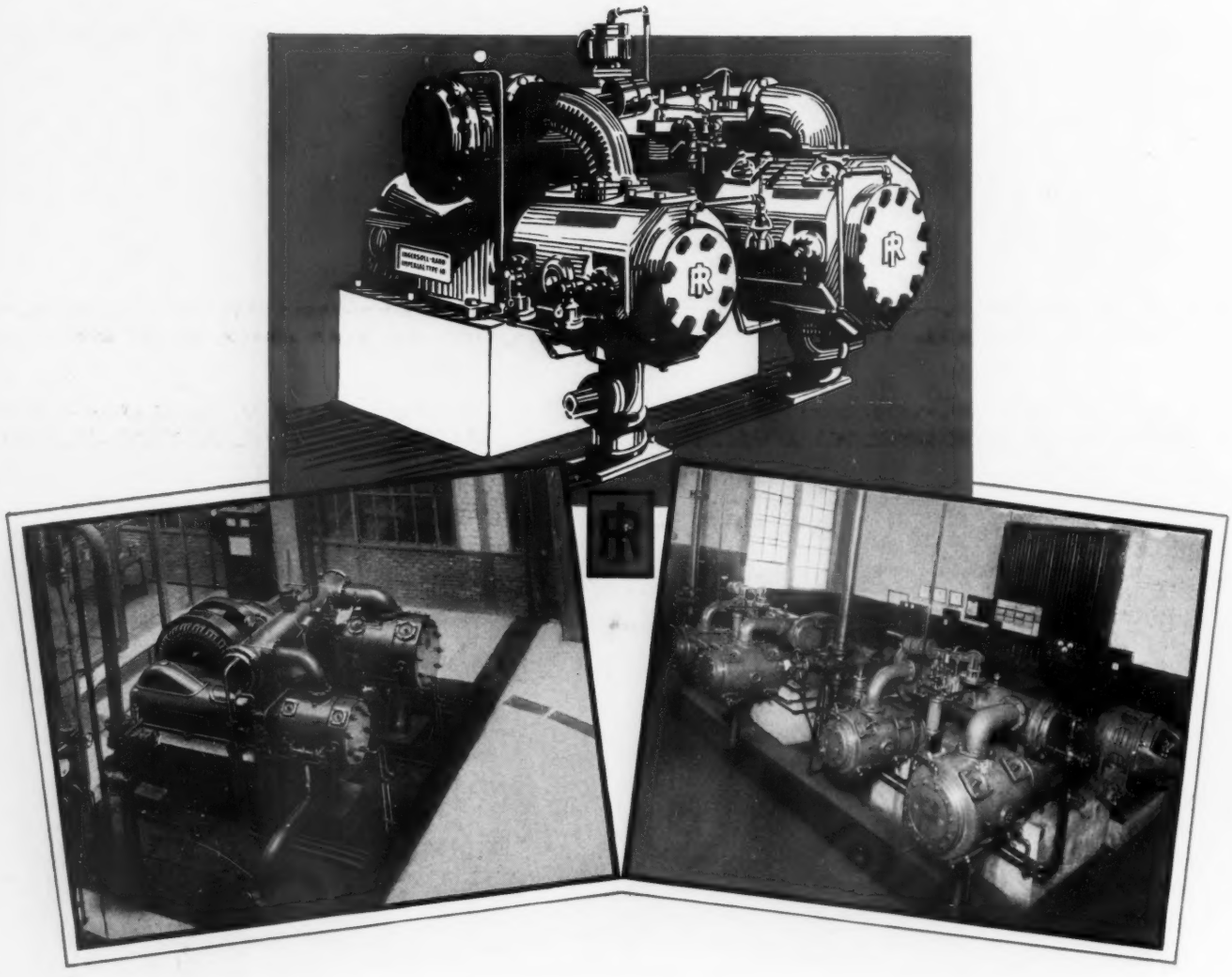
A Saving of $600 a Year



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Ingersoll-Rand compressors will, in many cases, effect substantial power economies. A saving of as little as ½ cent per 1000 cu. ft. of air delivered will amount to $600 per year on a 1000-cu.-ft. per minute compressor.*

These savings are possible with I-R compressors, because of their unusually high compression and mechanical efficiencies, and the economical unloading devices with which they are equipped. Each one of these items acts directly to reduce power consumption and cut operating costs.

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**Based on a 75% load factor, 9 hours a day, 300 days a year.*

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As It Seems To Us

THE HOOVER DAM BUILDERS

WE PRESENT in this issue another installment of the story of the Hoover Dam. We are sorry that space does not permit us to tell more about the men who are directing this monumental piece of work. For, after all, the completed structure will represent the sum total of the accumulated knowledge of many individuals. The casual observer will be prone to forget this fact when looking upon the dam and the reservoir it will create. He will, perhaps, fail to take into full account that they were born in the brains of men, and that without those brains, all the money and materials utilized would have been of no avail.

The individuals making up Six Companies Incorporated are collectively a board of experts. Among them are men who have previously met and solved every problem which will arise during the years of work that lie ahead. As operations proceed at top speed, and the scenes in this great construction drama change with unbelievable rapidity, the fact comes home that the fine coördination of the manifold phases involved is one of the most remarkable features of the accomplishment. Undoubtedly, the builders of the Hoover Dam smoothed many rough spots from their pathway with one sweep when they elected to place in one common reservoir the experiences and resources of six outstanding western contracting firms so that they might be tapped off as needed.

It is fitting that the Hoover Dam will primarily be the work of western men. President HOOVER, Secretary of the Interior WILBUR, and Commissioner ELWOOD MEAD of the Bureau of Reclamation, all call the section between the Rockies and the Pacific home. Their work is now largely done, and they can sit back and watch this great project take form in the competent and skillful hands of western builders.

Of equal interest is the fact that every state in the union is represented among the workmen at the dam site. While of the West and of chief value to the West, the finished structure will be the product of the nation at large.

GIRDERS ACROSS THE FATHER OF WATERS

BIG bridges are becoming as typical of American architecture as is the skyscraper. In the respect that they are placed wherever transportation demands dictate, and are accordingly not restricted to large cities, they are even more national in character than the lofty building.

Even before the record-breaking George Washington Bridge across the Hudson at New York was opened, work was underway on a more colossal suspension span at San Francisco. Meanwhile, the new arch bridge from Bayonne, N. J., to Staten Island has saved for Uncle Sam, by a scant few inches, the honor of having the longest structure of this type in the world.

Pittsburgh, the early field laboratory of JOHN A. ROEBLING, is perhaps the most bridged city for its size that we have. Its location at the junction of two rivers and its generally hilly topography have given rise to a group of imposing structures of steel, concrete, and stone.

The Mississippi River has its quota of bridges, the most famous being the Eads crossing at St. Louis, which marked the first use of compressed air in this country for foundation caisson work. Now the Father of Waters is to have another great span—this time near its mouth. The State of Louisiana and various railroads will jointly build the new structure at an estimated cost of $14,500,000. Years of exploratory work have finally determined that piers can be set on solid footings by going down a distance equivalent to the height of a 20-story building. Compressed air will doubtless play an important part in this precarious work.

The bridge will have sufficient clearance to permit oceangoing ships to pass under it. To accomplish this, the piers and the towers which will surmount them must have a combined height almost equal to that of the Washington Monument. The completed structure will rank among the greatest engineering accomplishments of the South.

MANHATTAN NOCTURNE

HAVING deprived some of the New York City subway turnstiles of their rasping clicks, the Electrical Research Products, Inc., has turned its attention to the diminution of noises accompanying the early morning pilgrimage of the milkman. Acting upon invitation of the Borden Company, this organization recently conducted experiments calculated to show that Manhattan can have both its milk and its undisturbed sleep.

It was found that by putting rubber cushions on bottles, the clatter largely disappears when they jounce about in the familiar carrier borne by the deliveryman. Perhaps the foes of noise knew that similar rubber boots have long been used to soften shocks to flasks of nitroglycerine being transported by truck. It was announced that the new insulator would gradually be applied until all routes in the city have been thus supplied.

Rubber tires on delivery vehicles were found to reduce by one-third the noise occasioned by the old style metal-girded wheels. As a final touch, the drivers were put in rubber-soled shoes and admonished against talking and whistling.

We may yet see the day when the advertising appeal of milk distributors in large cities is centered around some such slogan as that used by the New York Central Lines for many years. Suitably modified, it may read, "Use the Blank Milk Route—You Can Sleep."

AMERICA TAKES TO WINGS

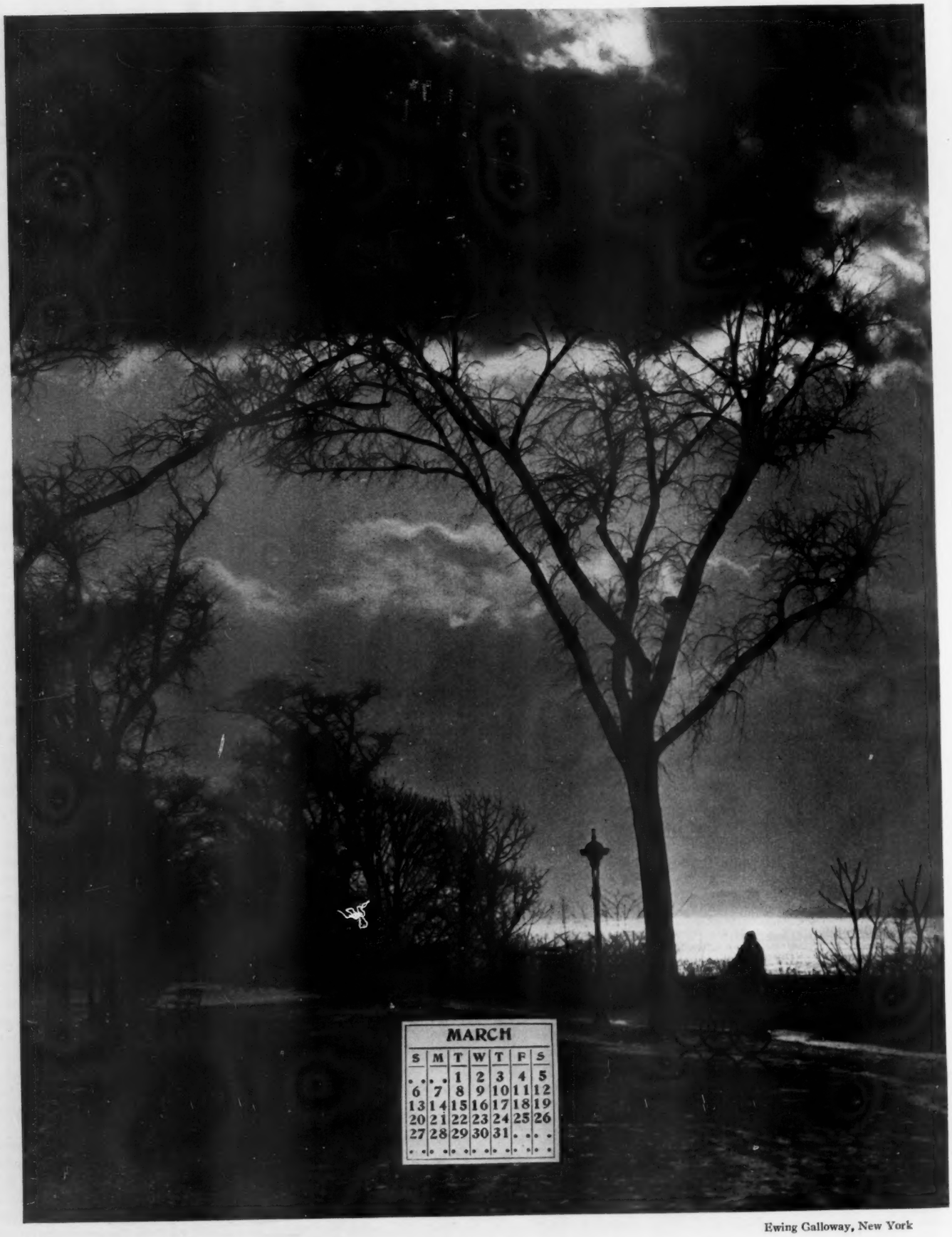
IT IS significant that despite the lameness which has slowed the gait of general business in recent times, America's newest transportation industry, the air lines, has gone forward at an undiminished rate. During a period of trial and tribulation to railroads and steamships, and of decreased automobile production, people have been taking to air travel with avidity.

United Air Lines, largest of the American systems, carried 23 persons in 1931 for every ten carried in 1930. Of the 43,000 persons who paid to ride, 23,000 patronized the 28-hour service from coast to coast. It is clearly evident that even with business struggling along at a slow pace, the individual American has not lost his liking for speed. The pronounced gain in air transportation during a year of tight money may be prophetic of a sky filled with planes when the nation again gets its bearings and locates Prosperity around that mysterious corner where she seems to delight in hiding. Planes of the company just referred to flew 11,000,000 miles in 1931—a distance equivalent to some 3,500 trips from New York to San Francisco. More than 50 per cent of the flying was done at night.

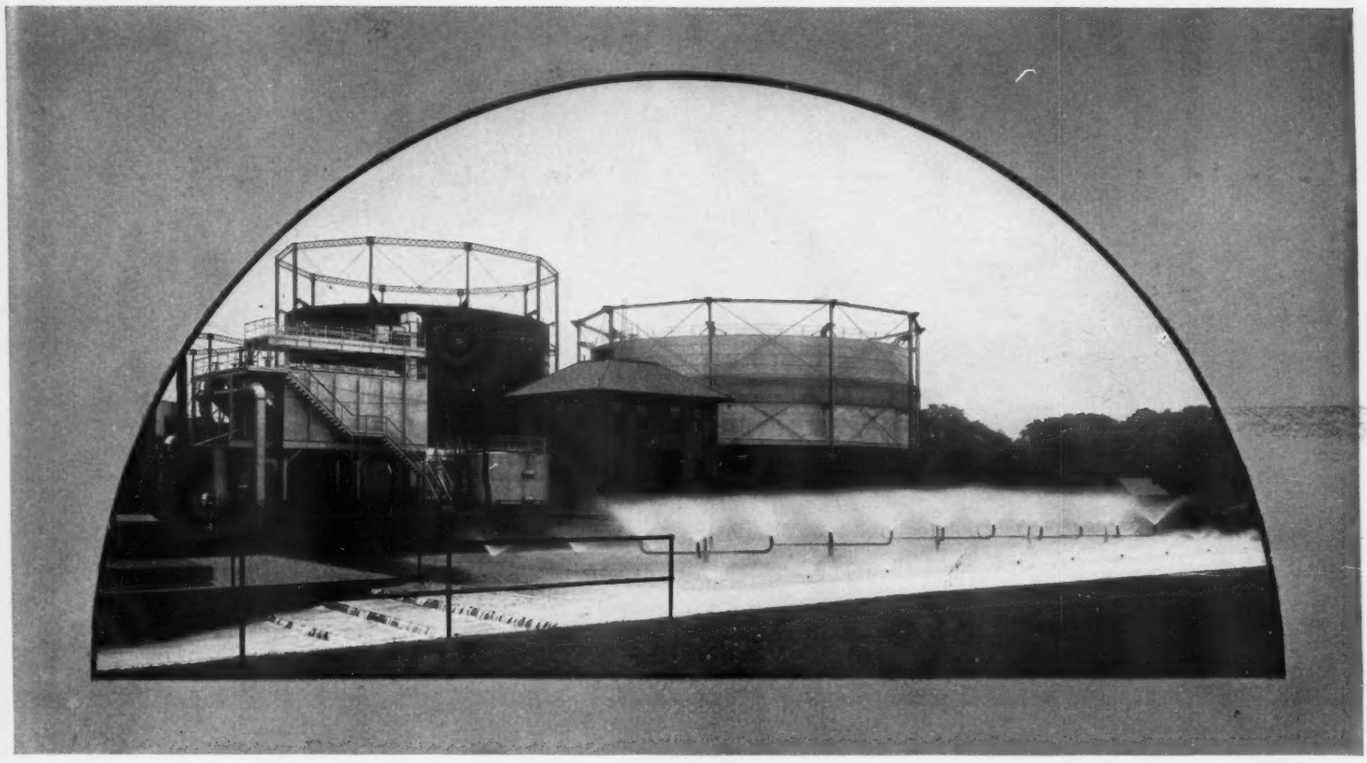
The volume of mail handled by air is even more impressive than the passenger count. The United Lines carried 2,420 tons of postal matter in 1931. Had it all been in the form of 2-ounce letters, nearly 40,000,000 of them would have been required to make up this weight.

A correspondent to a New York newspaper recently quoted an item from the *Daily Albany Argus* of January 12, 1835, recounting that a record of eighteen hours had just been set in carrying the mail from New York to Albany. One 20-mile leg of the journey was covered by the horses in one hour and twenty minutes, including three stops. The air-mail schedule from New York to Albany today is one and three-quarter hours.

The flying mail carrier is not only an accelerator of business; indeed, he gives all of us the luxury of putting off for another day or two the writing of that letter we owe, secure in the knowledge that it still will be delivered in good season and with all the prestige that an air-mail stamp conveys to the recipient.



Ewing Galloway, New York



Spray pond and low-pressure gas holders at the Hempstead plant of the Long Island Lighting Company.

Distributing Gas to Long Island Towns

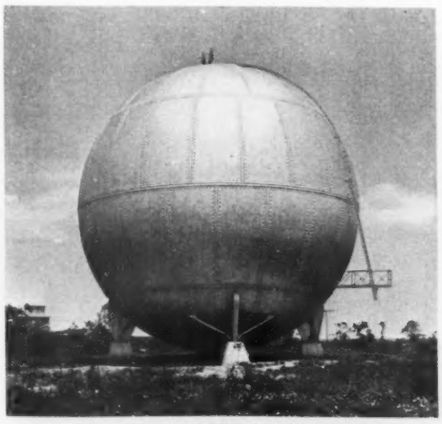
A Carefully Designed Distributing System is Necessary to Provide Satisfactory Service

A. W. LOOMIS

THE Long Island Lighting Company, with its subsidiaries, supplies gas to all of Long Island outside of New York City with the exception of the fifth ward in Queens County and a part of Brooklyn. The entire area is served by generating plants at Rockaway Park, Hempstead, and Bay Shore. In addition to the storage and the distributing facilities at these three plants there are a number of high- and low-pressure gas holders and distributing stations at strategic points in the system. The rapid growth of the district, and especially of that portion which lies in Nassau County and is supplied by the Nassau & Suffolk Lighting Company—a subsidiary of the parent company, has recently made it necessary to provide it with another compressor plant.

Nassau County is a 16-mile-wide strip located with its western edge some fifteen miles from Manhattan and extending from Long Island Sound on the north to the Atlantic Ocean on the south. It is largely residential in character; and the population is at the present time distributed in numerous communities. Actually, the area is approaching the nature of a large city and may, in a few years, attain a position similar to one of the boroughs of Greater New York. The inhabitants of the county already number something more than 300,000.

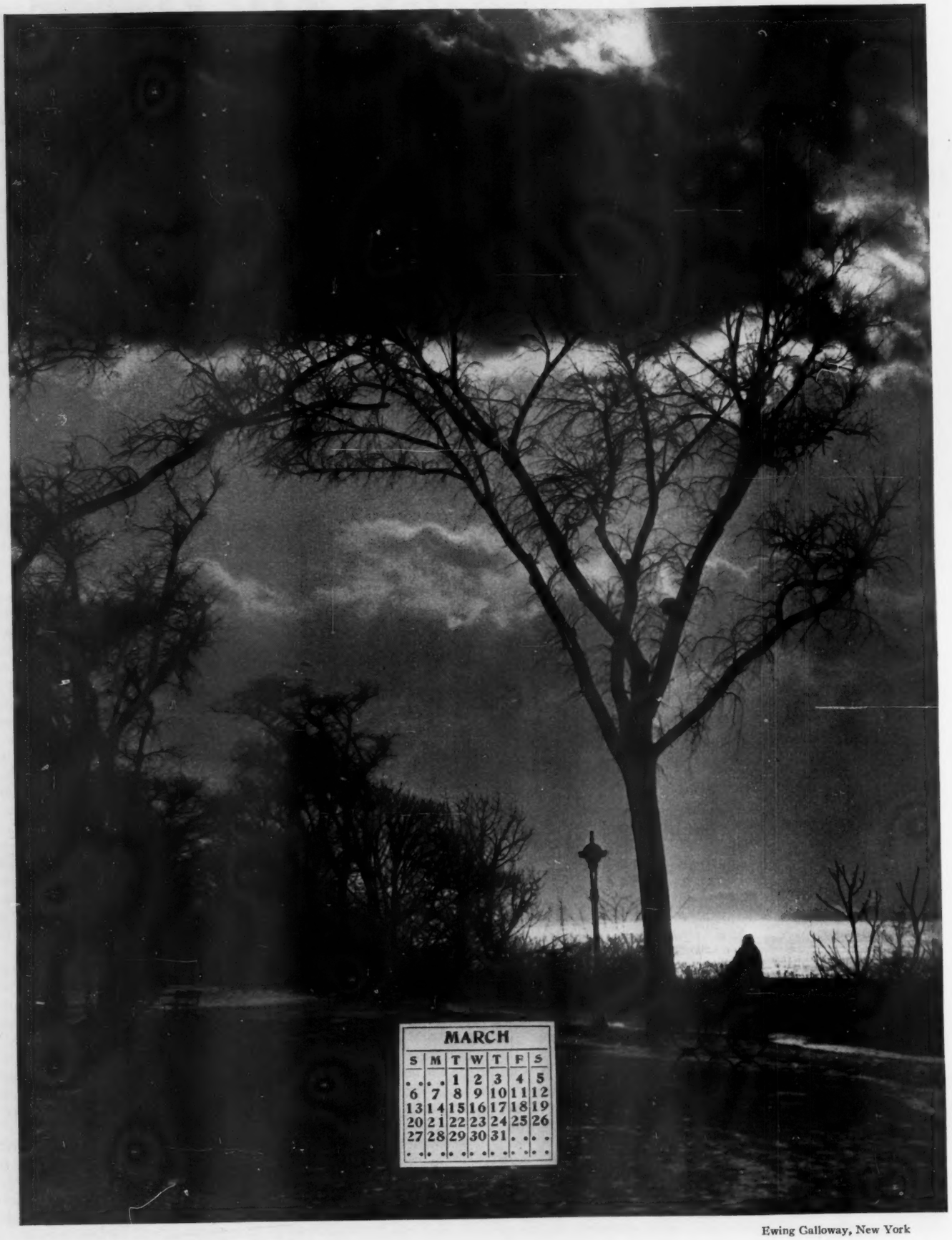
Because of its excellent resort and sport facilities, the population is considerably augmented during the summer months. Some 36 golf clubs attract the followers of that "Royal and Ancient Game", while thirteen yacht clubs on both the north and south shores lure the sea-minded. Devotees of the sport of Bill Tilden have plenty of opportunity to display their talents on the many private and public courts scattered throughout the towns. There are several polo fields in the county, and also the Belmont Park race track. Numerous bridle paths are provided for the pleasure of both man and horse. Even dog racing has its enthusiasts, as there is within the county at least one track where Whippet races are held. There are fine bathing beaches along both the sound and the ocean. Long Beach and the comparatively new Jones Beach on the south shore are perhaps the best known. A goodly expanse of state parks adds its bit of publicly owned beauty to the district.



One of the several Hortonspheres in the distributing system of the Long Island Lighting Company.

Such a concentration of ideal residence and play facilities within easy commuting distance of New York City has attracted an increasing number of permanent and summer residents. This growth in population has, of course, caused a corresponding rise in the use of gas. During the summer months, when a decrease in consumption is ordinarily to be expected, there is a steady demand for gas in the region because of the large vacation-period population.

The Long Island Lighting Company's generating plants are tied together by trunk lines so that, in the event of necessity, gas from any one of the stations can be sent to



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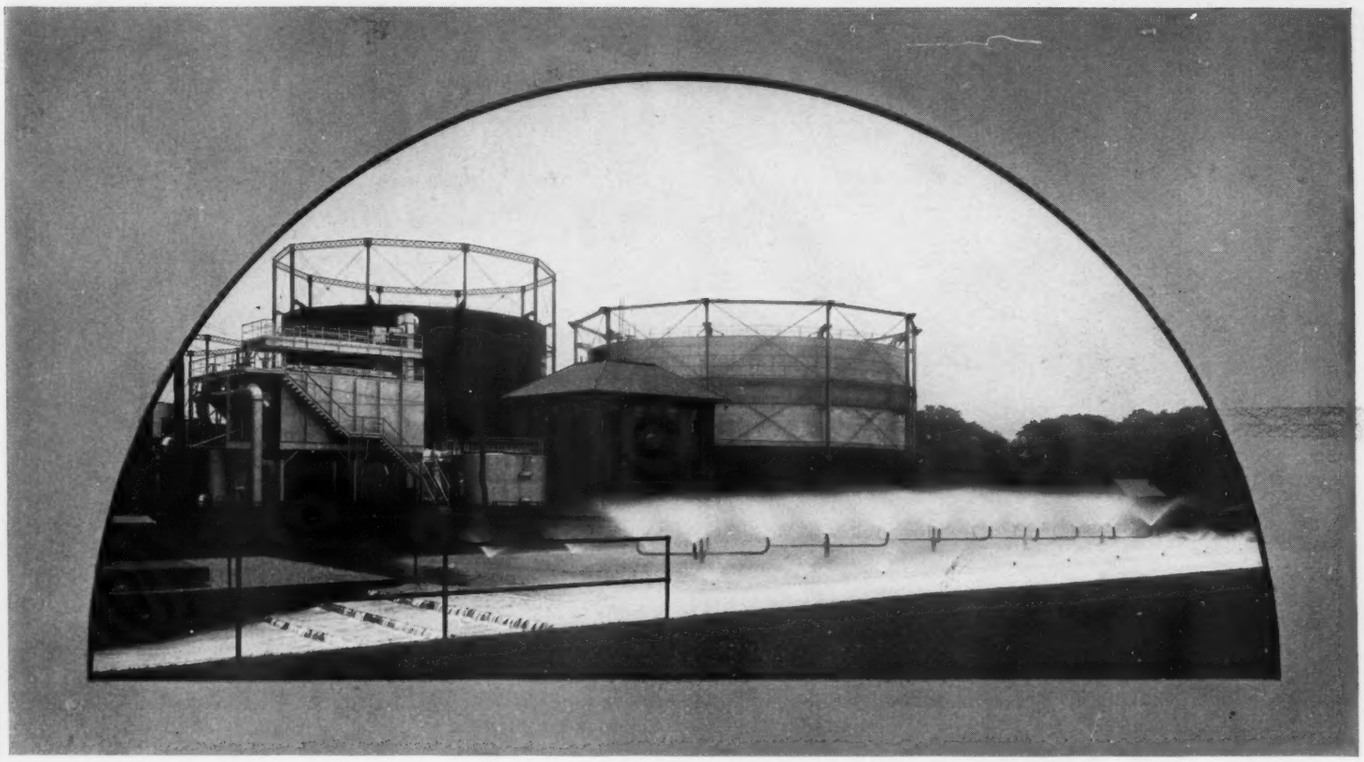

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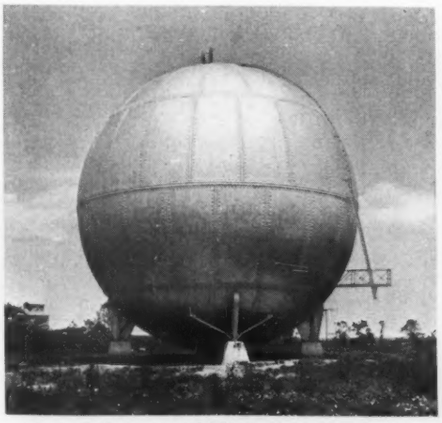

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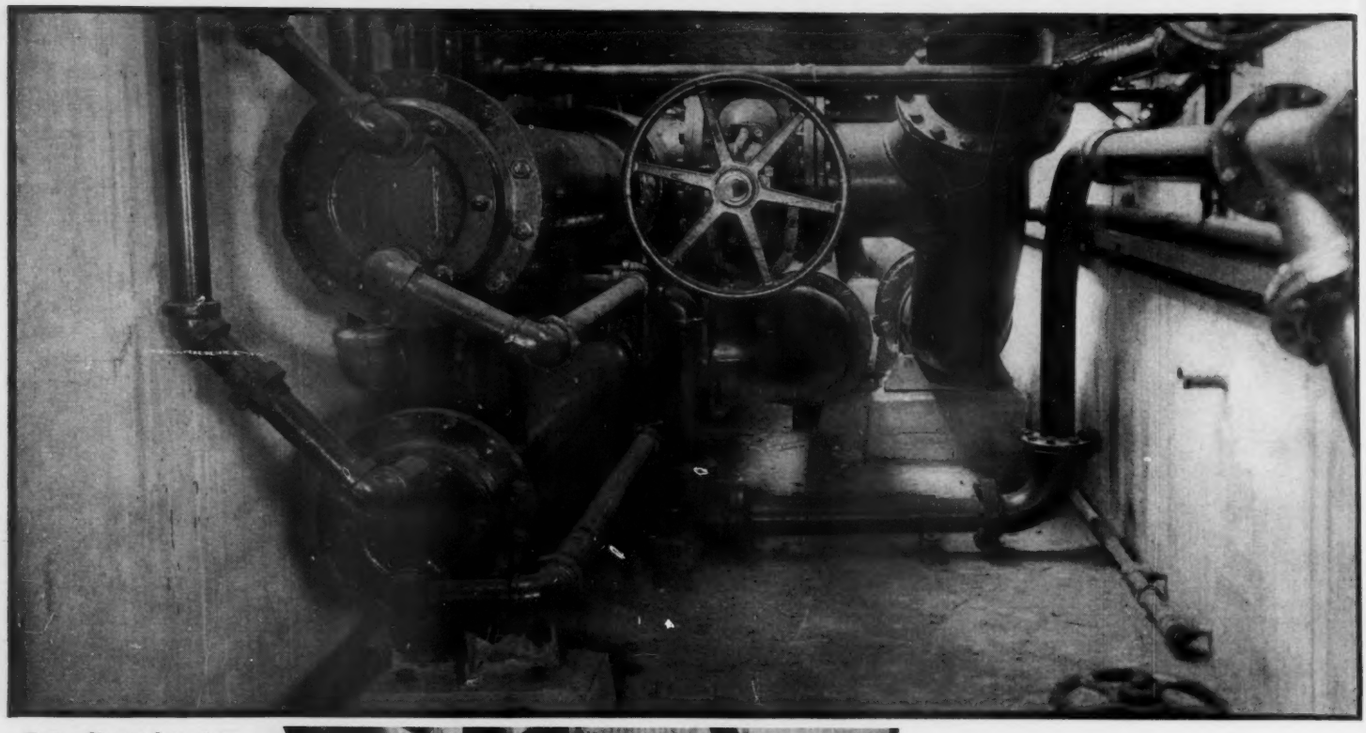
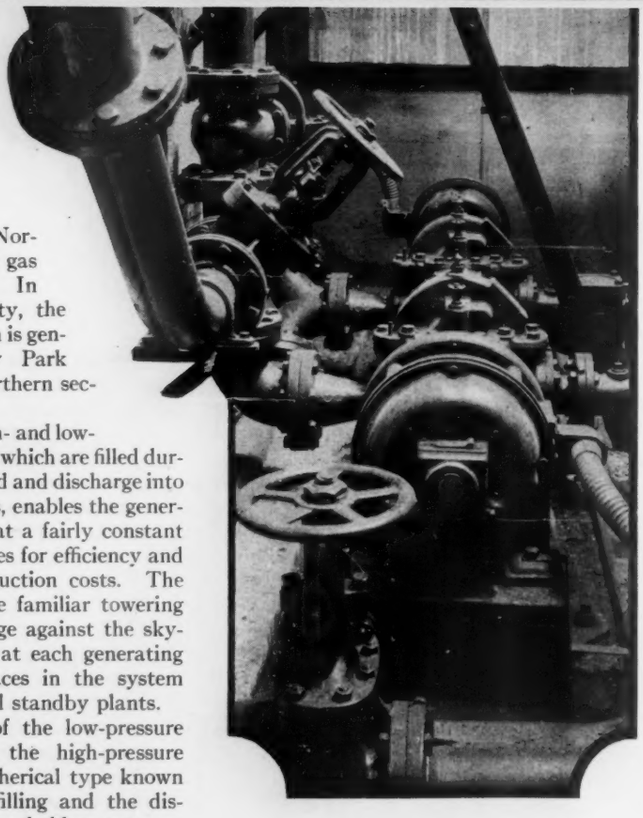


Gas aftercooler, top, and Cameron circulating-water pumps, right, at the Stewart Avenue compressor station.



any part of the system. Normally, each plant supplies gas to the region nearest it. In the case of Nassau County, the gas for the southern section is generated at the Rockaway Park plant, and that for the northern section at Hempstead.

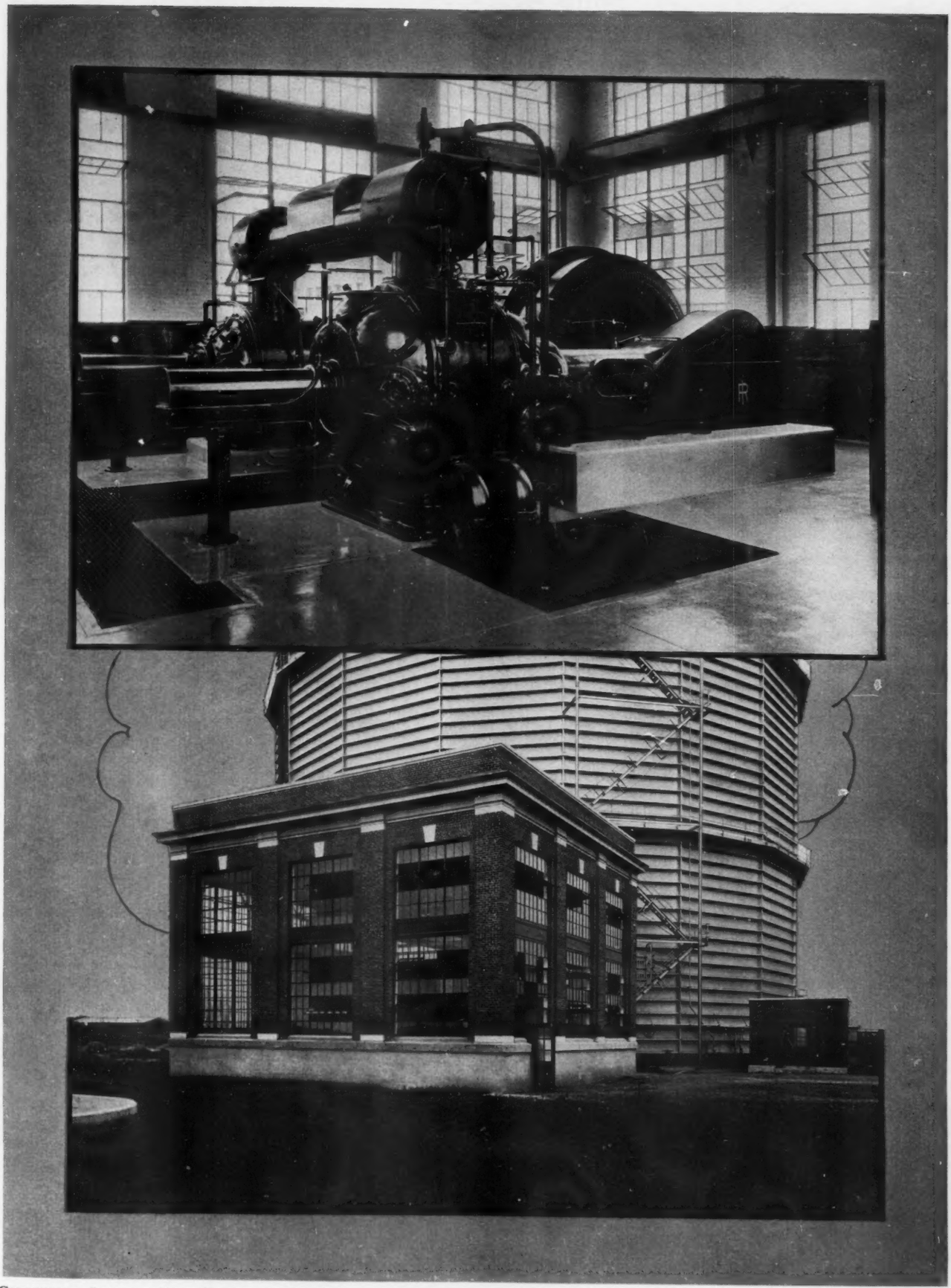
The judicious use of high- and low-pressure-gas storage tanks, which are filled during the hours of low demand and discharge into the system at peak periods, enables the generating stations to operate at a fairly constant rate. This, of course, makes for efficiency and helps to keep down production costs. The low-pressure tanks are the familiar towering cylinders that bulk so large against the skyline. They are available at each generating plant and at various places in the system where there are small local standby plants.

The storage capacity of the low-pressure tanks is augmented by the high-pressure tanks, which are of the spherical type known as Hortonspheres. The filling and the discharging of most of the gas holders are controlled by governors at the outlets and sometimes also at the inlets. In some cases, these governors are arranged so that the tanks fill when the line pressure exceeds a certain point and discharge into the system when the line pressure drops. Or the holders are regulated so that they will fill between certain hours of the day and discharge at others. Sometimes both pressure and time governors are supplied—the method of control being determined by the needs of the particular section in which the tank is located.

Compressors for pumping gas into the mains are installed at the generating plants and at such intermediate points of distribution as the service requires. As previously mentioned, the rapidly mounting demand for gas made it necessary to provide additional storage and compressor capacity in the district served by the Nassau & Suffolk Lighting Company. Near Garden City, two miles from the Hempstead generating plant, there was available a low-pressure gas holder with a capacity of 3,000,000 cubic feet. It was decided to utilize this storage volume in the establishment of the new distributing station. The Garden City tank receives its gas direct from the generating plants, and a compressor was required to pump this gas from the holder into the mains.

The Long Island Lighting Company makes every effort, particularly in a high-class residential and resort district such as the one under consideration, to have its stations as pleasing in appearance as possible. The cost, however, must not be excessive, and convenience cannot be sacrificed to beauty. The generating plant at Hempstead, with its landscaped grounds and glistening spray pond, is an excellent example of what can be done along these lines.

The new compressor house at Garden City is a fine-looking structure of brick and concrete set at the base of the towering gas holder. Long windows on four sides of the building give ample light. The station has been so designed that it can be enlarged to accommodate another compressor when conditions require, and this addition can be made without destroying the symmetry of the building or interfering in any way with the operation of the present equipment. Inside is the large compressor which was selected for this job. It is an Ingersoll-Rand 43 & 28x30-inch PRE-2 synchronous motor-driven unit rated at 350,000 cubic feet of gas per hour at 75 pounds per square inch discharge pressure. The switchboard and control mechanism are located in a separate room in one corner of the plant. All piping is below the floor. The compressor is equipped with automatic 4-step clearance control and an automatic by-pass which allow the unit to be partly or com-



Compressor house and synchronous-motor-driven gas compressor, with an hourly capacity of 350,000 cubic feet, at the Stewart Avenue Station of the Nassau & Suffolk Lighting Company.

pletely unloaded at any discharge pressure. The clearance valves are operated with air furnished by a Type 30 compressor.

The work of the compressor is to take gas from the holder and to pump it through an HM-4 aftercooler into the mains which serve the towns of Manhasset, Glen Cove, Oyster Bay, Port Washington, Sea Cliff, and others. The piping is so arranged that the compressor can take gas not only from the holder and pump it into the mains but also from one set of mains and pump it into another set, or the gas may go directly to the mains from the holder without passing through the compressor.

The cooling-water system for this compressor is essentially a closed one. This type was selected because of the expense of using water from the city mains and the difficulty of disposing of it afterwards. The water is pumped through the intercooler, the compressor water jackets, and the aftercooler to the aforementioned spray pond. This pond is divided into two sections. Under normal conditions the water is cooled by spraying in but one of them; but on particularly hot and sultry days, when insufficient cooling is obtained by this method, the water may be resprayed in the other section.

Two Cameron pumps circulate the water through the compressor, the intercooler, and the aftercooler, and force it through the spray heads in the cooling pond. There is a connection with the city water system so that make-up water can be added, as needed. Both the pumps and the aftercooler are mounted in a roomy, well-drained, and well-lighted pit below the floor level of the compressor house. This pit and those that carry the gas piping are easily accessible through floor gratings.

The plant was designed and built by E. L. Phillips & Company, of New York, and every care was taken to provide a station that would be pleasing in appearance as well as efficient and economical in its operation. The result is all of that, and well worth the effort.

The University of California is said to have developed a process that makes it possible to impregnate standing timber with preservatives. Holes are bored close to the ground in the trunk of a living tree, and into these is injected a solution of copper and arsenic at the season when the sap is rising. The claim is made that the preservative penetrates the wood completely within 24 hours, causing it to become immune to the attack of termites and marine borers. It costs $5 to so treat a large tree. This brings to mind a kindred method, that was experimented with several years ago, of dyeing the wood of a standing tree any desired color.

BRITISH WEIGH ADVANTAGES OF DIESEL-ELECTRIC TRACTION

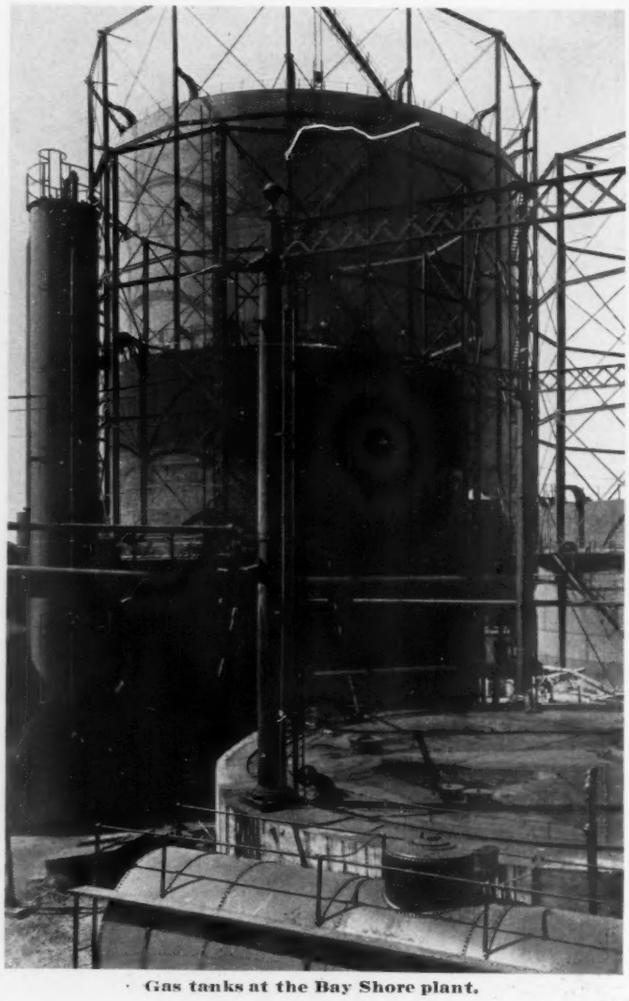
IT HAS recently been stated in the British press, according to *Commerce Reports*, that the adoption of Diesel electric traction by the British railways would cost less than half that of the electrification proposed by the Weir report, being £150,000,000 as compared with £340,000,000, and would show more than double the return.

The estimated capital cost for oil-electric tractors is two and a half times the estimated cost of replacing all the steam locomotives discarded, this being for more powerful oil-electric tractors capable of handling the rapid freight and the stopping passenger services envisaged in the Weir report for electrification. The average cost of each oil-electric locomotive is said to be three and a half times that of each steam locomotive; but 30 per cent fewer oil-electrics would be sufficient, compared with the present system.

Even with the great difference in first cost, the saving in operation is claimed to be such as to return substantially 15 per cent on the capital outlay as against 6½ per cent, according to the Weir electrification scheme. For an equivalent service, the first cost per locomotive would be considerably less and the return correspondingly greater. A rough estimate shows that the return might approach 25 per cent.

It has been estimated that a 4-coach train, running a stopping service in the Midlands, could save 9 pence per mile as contrasted with steam traction, and a main-line freight locomotive hauling 800 tons could save from 10 pence to 1 shilling 2 pence per mile. Light oil-electric rail cars are already being introduced on certain branch lines, and it is said that they will save at least a shilling per mile over steam trains, besides being more powerful and more rapid than the steam rail cars at present in use on some of the lines.

If the Diesel electric system be adopted on the main lines in Great Britain, as is now being urged, it is claimed that it will result in the immediate employment of 1,200 Newcastle-on-Tyne engineers, with the prospect of a larger number later; of 23,000 miners to supply 7,000,000 tons of coal required for oil production; and of 20,000 men in coal-to-oil reduction plants, as well as in the saving of £22,000,000 in the working costs of the railways. The statement has been made that the Diesel electric system could be put in service at once with no capital outlay by placing the Newcastle-on-Tyne built trains on the lines. The heavy-oil fuel that would be utilized is said to be cheaper than gasoline and to give about 50 per cent more mileage to the gallon.



Gas tanks at the Bay Shore plant.

VACUUM-PACKED NUTS FROM INDIA

CASHEW nuts, of which large quantities are shipped from India to the United States, have been added to the growing list of foodstuffs now packed under vacuum to preserve their flavor and freshness. The clean, graded kernels are shipped in tins having a capacity of 25 pounds each. Before filling, oiled paper is laid on the bottom of the container, and the nuts are then packed with special care to prevent breakage. After more oiled paper has been placed on top, the cover is soldered on and punctured.

With this done, the tin is ready to undergo the evacuation process, which consists of withdrawing the air through the puncture by means of a vacuum pump. When the pressure gage registers 10 pounds, the vent hole is promptly sealed, because then complete exhaustion is known to have been accomplished.

An improved storage plant for crushed stone and gravel consists of a high octagonal tower in which are arranged the classifying screens. Partitions radiate from this tower like the spokes of a wheel, forming separate compartments for the different grades produced.

New Method of Obtaining Earth Cores

ANOTHER application of portable air compressors and air hoists has been made in connection with a new method of subsoil explorations recently developed and patented by the A. J. Forschner Construction Company, of Chicago.

The new method obtains and brings to the surface for inspection a complete core of undisturbed earth for the full depth to which explorations are desired. This is accomplished by driving successively two steel shapes, an angle and a channel, so arranged that when driven they form a closed casing within which is the core of earth. The angle is first driven to any desired depth. The channel, with the flanges at the lower end crimped in to make it follow the angle, is next driven to the same depth. The angle and channel, with their enclosed core of earth, are then pulled up together, laid on the ground, and separated, thus exposing the earth core.

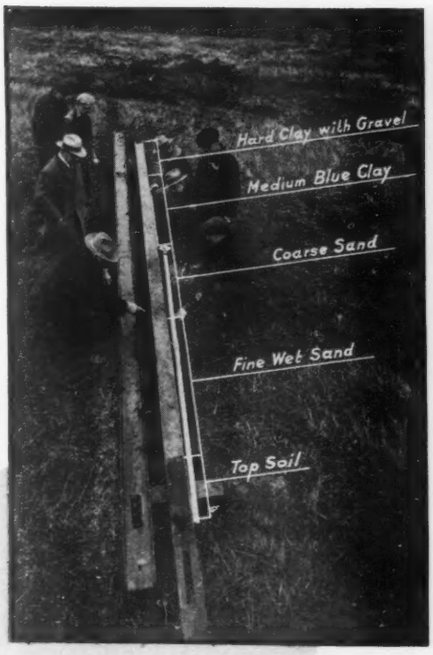
This method has just been used very successfully on the West Side Sewage Treatment Works of the Sanitary District of Chicago, where cores were obtained extending to a depth of about 40 feet. The ground encountered comprised a great variety of soils, including top soil, peat, deposits of shells, quicksand, yellow and blue clays of varying hardness, and hardpan.

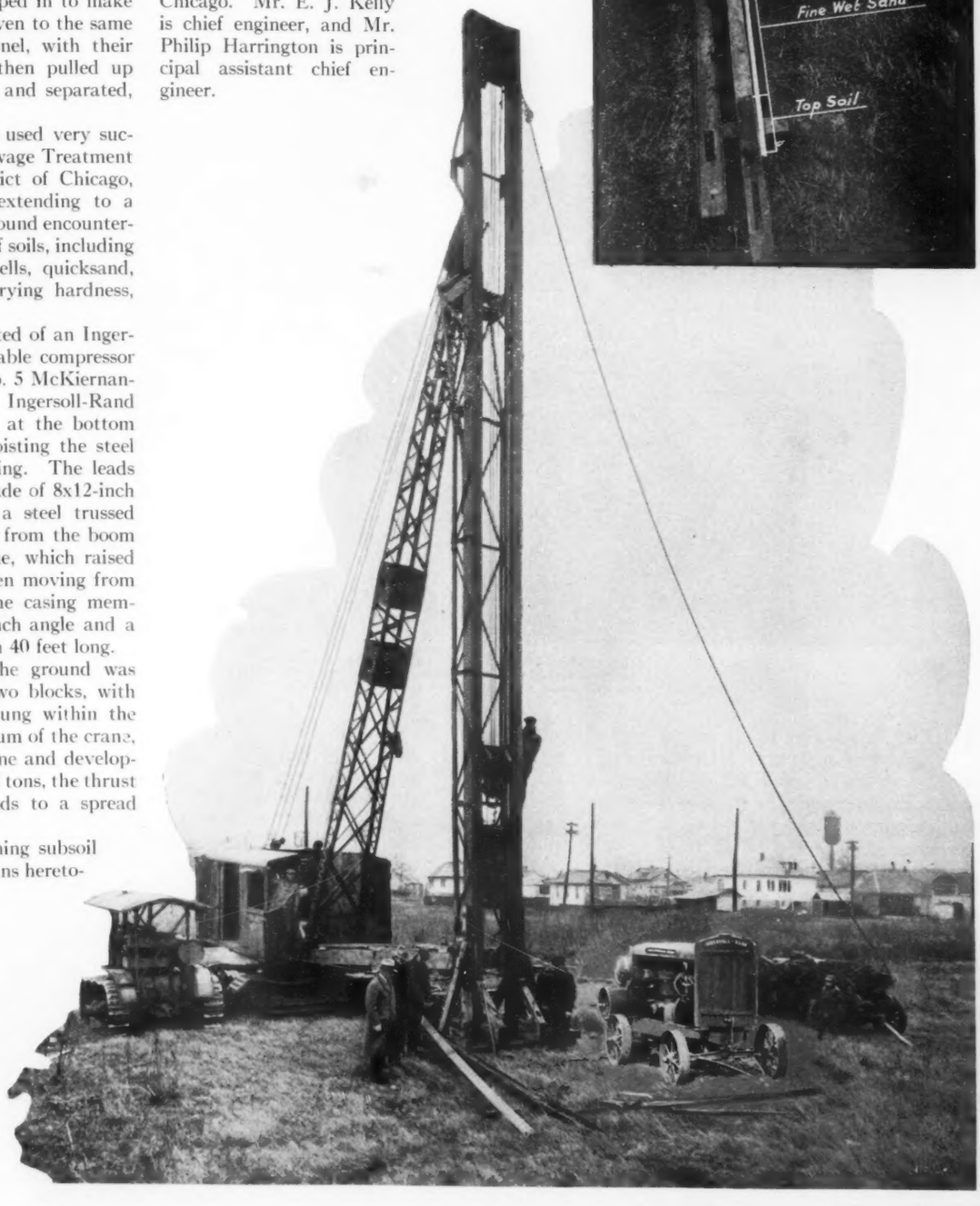
The equipment used consisted of an Ingersoll-Rand 310-cubic-foot portable compressor supplying air for driving a No. 5 McKiernan-Terry pile hammer. An Ingersoll-Rand "Utility" air hoist, mounted at the bottom of the leads, was used for hoisting the steel shapes into position for driving. The leads were 56 feet in length and made of 8x12-inch timbers rigidly braced with a steel trussed frame. The leads were hung from the boom of a No. 104 Northwest crane, which raised them clear of the ground when moving from one location to another. The casing members consisted of a 4x4x$\frac{5}{8}$-inch angle and a 7-inch 20-pound channel, both 40 feet long.

Pulling the casing from the ground was accomplished by means of two blocks, with six sheaves in each block, hung within the leads and connected to one drum of the crane, thus giving twelve parts of line and developing a pulling power of about 75 tons, the thrust being borne through the leads to a spread base on the ground.

This new method of obtaining subsoil data is far superior to any means heretofore used. The core obtained is undisturbed earth to any depth desired. The exact thickness and character of the various strata can be accurately measured and examined. The moisture content of each stratum, varying from wet quicksand to dry hard clay is clearly shown. The relative hardness of the ground at different depths and its consequent bearing value can be easily determined.

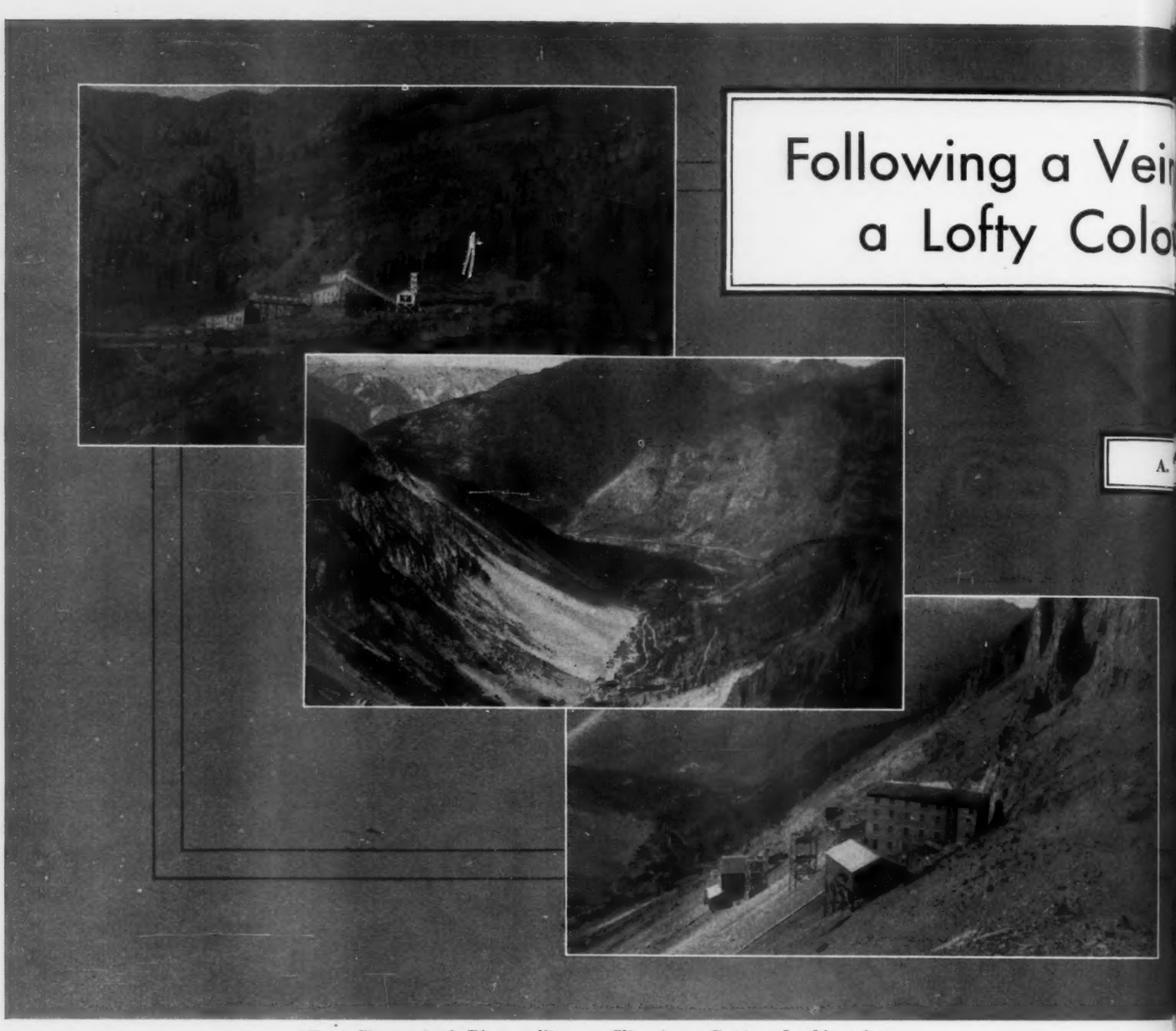
The subsoil explorations recently conducted at the West Side Sewage Treatment Works by the A. J. Forschner Construction Company were made under the direction of L. B. Barker, principal construction engineer of the Sanitary District of Chicago. Mr. E. J. Kelly is chief engineer, and Mr. Philip Harrington is principal assistant chief engineer.





Equipment used in obtaining subsoil data by the method described. Top—The channel and angle irons separated after withdrawal and revealing a complete core of the ground penetrated.

Following a Vein of a Lofty Colorado



Top—Shenandoah-Dives mill near Silverton. Center—Looking down Arrastra Gulch from the mine. Bottom—The mine buildings, perched on the side of King Solomon Mountain at an elevation of 11,200 feet.

THERE is a saying in the mining sections of the western United States that high-grade mines can be found, but that low-grade mines must be made. The truth of this statement is found in times such as we have been experiencing, when the prices of all metals except gold are sharply depressed. Aside from the few rich gold properties, the only mines that operate steadily in the face of deflated metal returns are those that have been planned and developed along strictly business lines. Mining, in common with all business, is a gamble at best, but business methods of the sort found in well-conducted companies in other industrial fields can and do reduce the element of chance to a minimum.

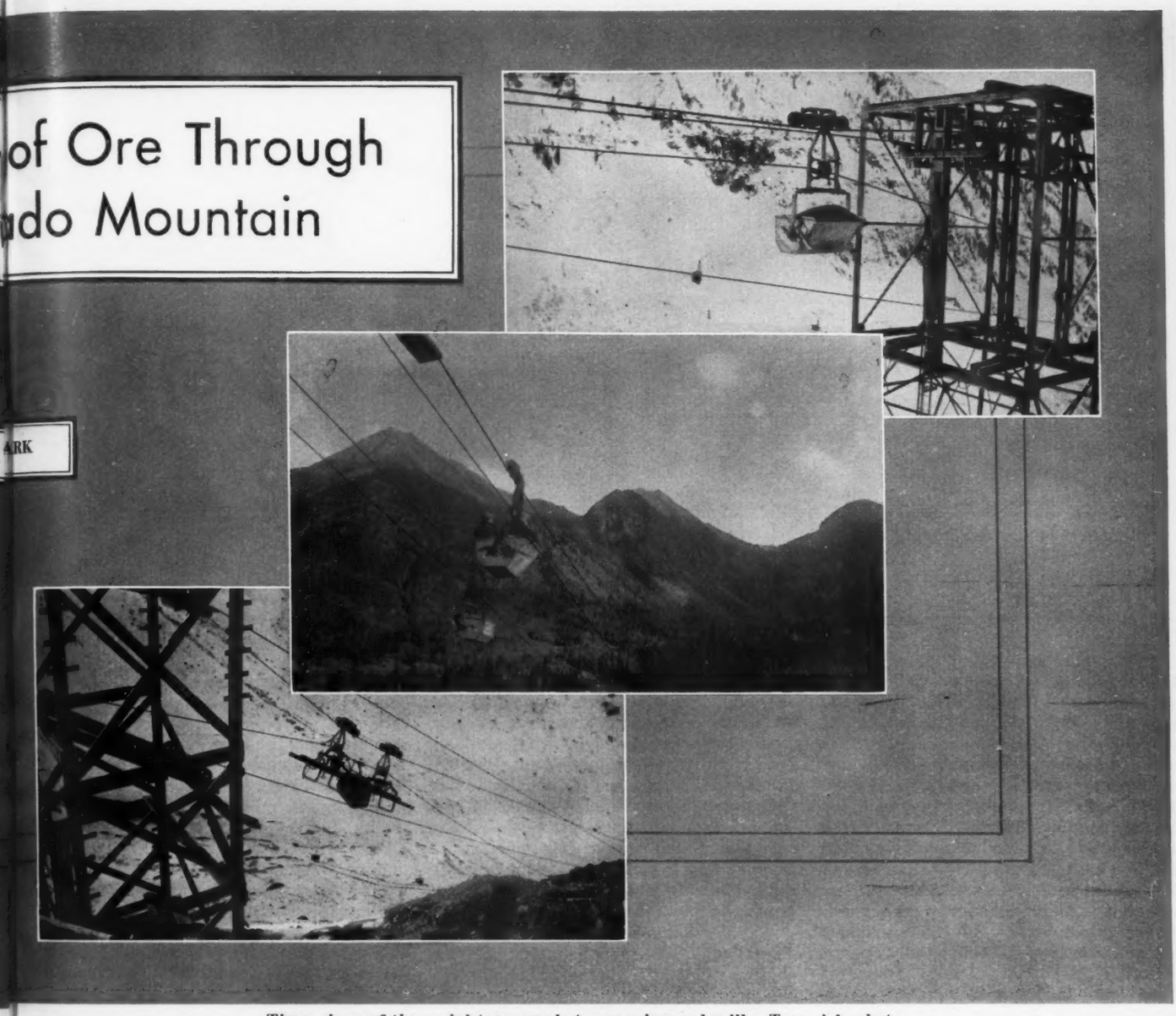
A concrete example of what is meant is furnished by the Shenandoah-Dives Mining Company of Silverton, Colo., which has successfully launched a low-grade mine during an economic crisis. It is a large-scale operation which represents a consolidation of smaller properties. To operate the individual mines would have proved too great a gamble for the returns in sight; but by combining them and working the entire group through the most advantageous approach, it has been possible both to increase the potential ore supply and to lower the cost of handling it. Thus has the inherent gamble been reduced.

From the outset, business methods as exemplified by established industrial concerns have been practiced. For instance, no considerable outlay was made for plant and equipment until the existence of a large amount of ore was made known through exploratory work. Once this was determined, steps were taken to develop a large tonnage and to mine, transport, and mill it in the most efficient and most economical manner. The result is a thoroughly modern set-up, which can be maintained at reasonable expense and which is good for many years of service. To understand what has been accomplished, it will be helpful to set down here something concerning the background for the venture.

Silverton is located in the high, semi-isolated San Juan Mountains of Colorado which are characterized by extreme ruggedness. The region has been a mineral producer for half a century, during which time its fortunes have risen and fallen with those of the mining industry in general. The principal returns have been from gold, silver, lead, and zinc, although numerous other metals have been produced in varying amounts.

Because of the precipitous nature of much of the region and the consequent difficulty and expense of transporting ores, the practice in the early days at the more inaccessible mines was to save only the high-grade ores. For the most part, these were sacked and packed on mule back to the railroad for shipment to the smelter at Durango, 50 miles

# of Ore Through do Mountain



Three views of the aerial tramway between mine and mill. Top—A bucket of ore passing a tower. Center—Two miners starting the 2-mile trip to the mine. Bottom—A crusher mantle, supported by two timber carriers.

away. Later on, mills for the concentration of the leaner ores made their appearance, and with them came aerial tramways for the transportation of ores, materials, and men between mines and mills. These trams became characteristic of the San Juan area. Some of them, such as that between the Sunnyside Mine and mill, were three miles or more in length.

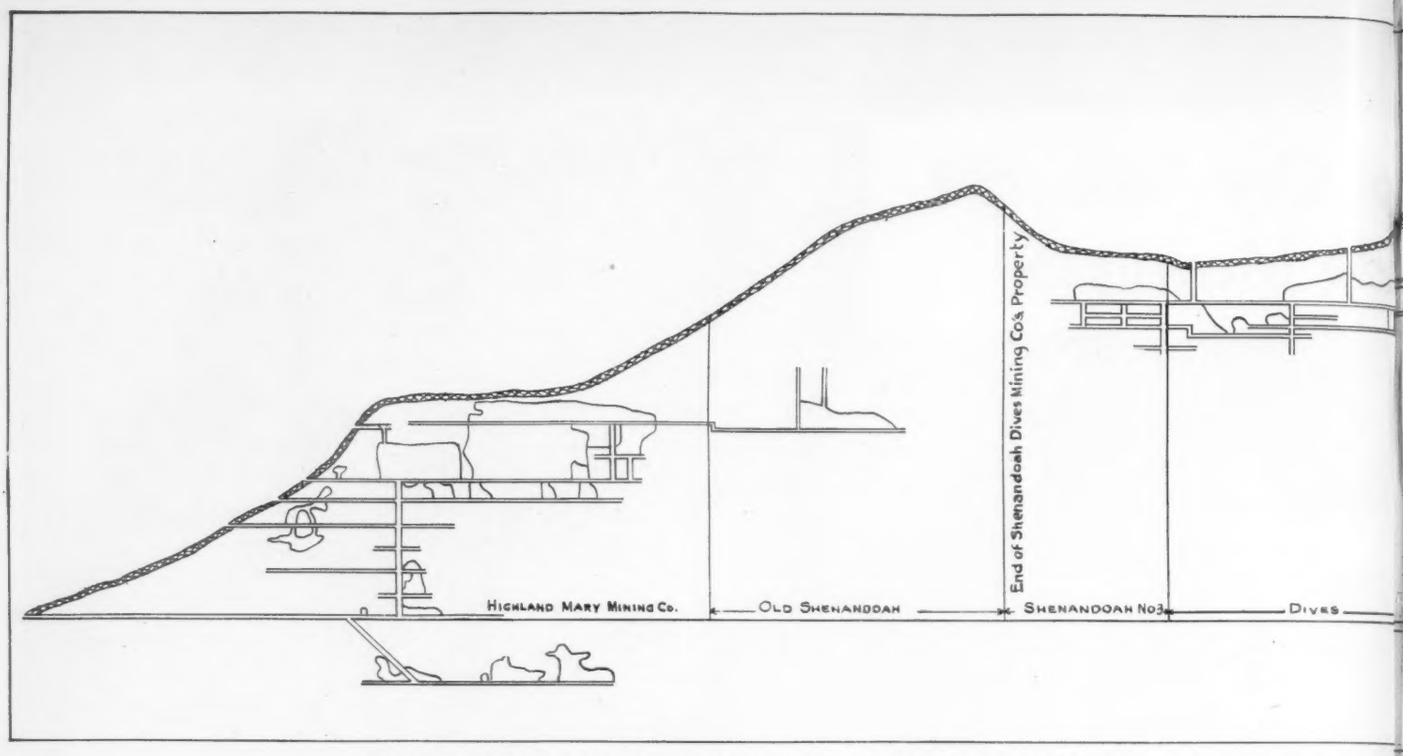
Some 30 years ago, one Dan MacLean served as manager of the smelter at Durango. With typical Scotch prudence and foresight, he began to study the records of ore shipments to learn which mines were sending in the best mineral. After a few years of this, he began to seek and obtain leases on properties that he knew to be desirable. Later he resigned his smelter connection to make leasing his business.

Among the claims that Mr. MacLean worked at a profit for several years were the Highland Mary, Shenandoah, and Dives. All lay along one end of a well-defined vein that crosses King Solomon Mountain in a southeast-northwest line. Covering the other end of this vein, on the Arrastra Gulch side of the mountain, were the Mayflower, Slide, Terrible, and North Star claims. These were assembled by G. H. Malchus, a pioneer in the section, who worked the Mayflower and North Star with good results. Reference to the accompanying diagram will show the relation of these various claims to one another and to the apex of King Solomon Mountain.

In 1925, these various properties, which had been idle for some time, came to the attention of Charles A. Chase, a well-known mining engineer previously in charge of operations at one of the large mines in the Telluride area a few miles away. His investigations revealed the past productions to have been $1,250,000 from the Shenandoah-Dives, $2,000,000 from the North Star, and $250,000 from the Mayflower. The Shenandoah-Dives and North Star had been essentially silver mines, although productive of lead and some gold; from the Mayflower the values had been chiefly in gold, with silver, copper, and lead in lesser amounts. While these figures were authenticated, they represented returns from rich surface ores. Any future production had to come from deeper zones; and available engineering reports deprecated the existence of deep ore bodies.

However, Mr. Chase concluded that the lower zones would, in reality, prove to be mineral bearing. He interested a group of Kansas City men, headed by James W. Oldham, who organized an informal syndicate for preliminary development of the properties and took options on three groups of claims which covered the vein continuously for 8,100 feet.

For preliminary work, the Shenandoah-Dives offered the best working entrance, although its elevation of 12,100 feet and its



Sectional drawing showing new and old workings on King Solomon Mountain. The portions of the wo[illegible]one by

difficult approach through the gorge of Cunningham Gulch were against its suitability for permanent use. In an effort to prove his belief that ore existed at depth, Mr. Chase elected to drive two drifts under the old North Star workings from Shenandoah-Dives ground. This work was done during the first nine months of 1926, and for their entire length of 800 feet these openings were in ore of milling grade. At this time, Mr. Chase called in Orville R. Whitaker, Denver consulting engineer, who studied the property and concurred in Mr. Chase's conclusions and his recommendation that the properties be worked as a unit.

Since the old Mayflower portal at 11,200 feet elevation in Arrastra Gulch was easily the most accessible point of attack, operations were shifted to that point in October, 1926. The working plan then in mind called for driving a long drift into the heart of the mountain, raising a 2,000-foot shaft to the surface, and mining all the intermediate ground through the retreating system. This plan was modified when, in August of 1927, a good grade of milling ore was struck in the middle of the Slide claim, about 1,500 feet in from the portal.

A few more months of operation proved the existence of a large body of ore and, early in 1928, a sub-lease was taken on an old concentrating mill a short distance below the Mayflower portal. Gravity and flotation concentrating equipment of 100 tons daily capacity was installed and in operation by June. Ore derived almost entirely from development work proved sufficiently rich to make the enterprise more than self-supporting. For a period of ten months it averaged 0.32 ounces in gold, 5 ounces in silver, 0.7 per cent in lead, and 1.4 per cent in copper to the ton.

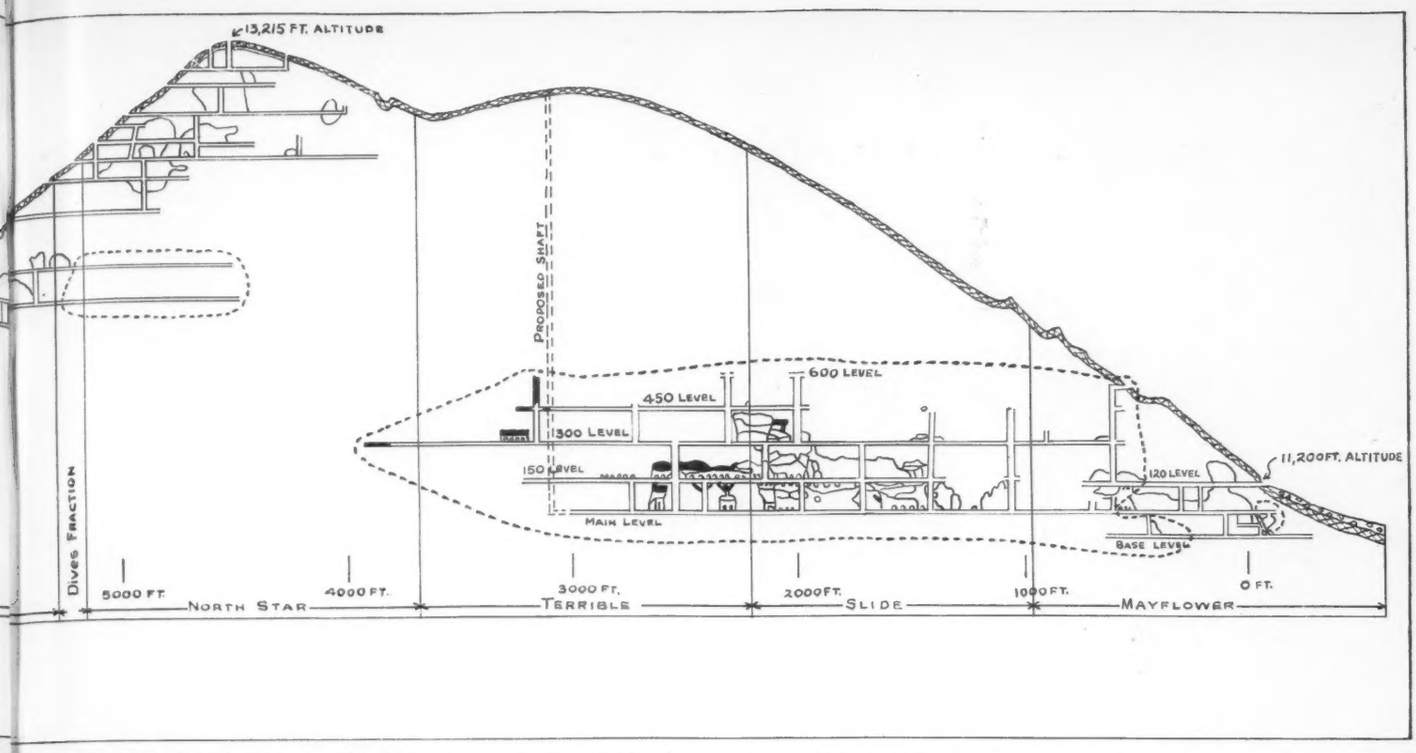
During all this period the venture had been essentially a prospecting exploration, and expenditures for plant and equipment had been confined to bare necessities. By 1929, however, the results had fully supported Mr. Chase's hypothesis. The presence of $1,200,000 worth of ore within narrow limits had been proved, and it was decided to equip the property for large-scale production. Accordingly, in April of that year, the syndicate organized the Shenandoah-Dives Mining Company, a Colorado corporation. Through sales of securities, funds were provided for a $700,000 program of construction and improvement. The principal items of outlay were: mine equipment and crushers, $80,000; mine house and office, $40,000; aerial tramway, $85,000; mill, etc., $375,000; working fund, $50,000. The construction was completed in February, 1930, and operations of mining, transporting, and milling began on a 300-ton basis. Since then they have been increased to nearly 600 tons.

An R-51 "Stopehamer" at work.

As the mine portal is located on a steep slope, level space for buildings was at a premium. Fortunately, some of the old underground workings could readily be adapted to certain uses. The compressor room and the blacksmith shop occupy rooms near the portal just off the main level. Old stopes below the main level were enlarged to accommodate the crushing plant.

Surface buildings constructed at the mine were, a timber shed, at the main level portal, and a 4-story-and-basement frame structure which houses the kitchen, dining room, commissary, recreation room, offices, first-aid room, and living quarters for the personnel. Walls and roof of the latter structure are insulated, and steam heat is provided.

King Solomon Mountain is a mass of igneous rock consisting of a basement of Eureka rhyolite, which is general throughout the region, overlain by latite, the principal productive horizon. The vein that is being followed cuts across the mountain in a plane that dips from 50° to nearly vertical. Running parallel to it, and sometimes wholly contained within it, is an intruded dike of andesite which has been traced above and below ground for a distance of 2,000 feet from the mine portal. The vein varies in width from



the wo done by the Shenandoah-Dives Mining Company are shown within the areas bounded by broken lines

10 to 30 feet, and the mineral is distributed irregularly through its filling of quartz and altered country rock. In places, the vein spreads out into a system of small stringers and veinlets. In other places the vein is compact, but is paralleled on either side by small stringers 20 or 30 feet away. The economic minerals are those containing gold, silver, lead, and copper. The gold and silver are largely contained in the copper mineral, chalcopyrite. The lead occurs as galena and anglesite.

Under the modified plan of producing from ground already opened up, and meanwhile working toward the original objective of a long drift with a shaft from it to the mountain top, work is being carried on from several levels. The main entry for both mining and haulage is an 8x8-foot drift, which was the first entry into the mountainside. At intervals of 300 feet along this level are driven raises 16 feet long and as wide as the vein, and on them stations are cut each 150 feet of vertical distance. The maximum height to which any of these raises have thus far been carried is 600 feet. As mining proceeds, the stations are connected by levels. The 300-foot level has been driven ahead of raising operations from the main level and has penetrated 4,000 feet along the vein, as compared to 3,000 feet for the main level.

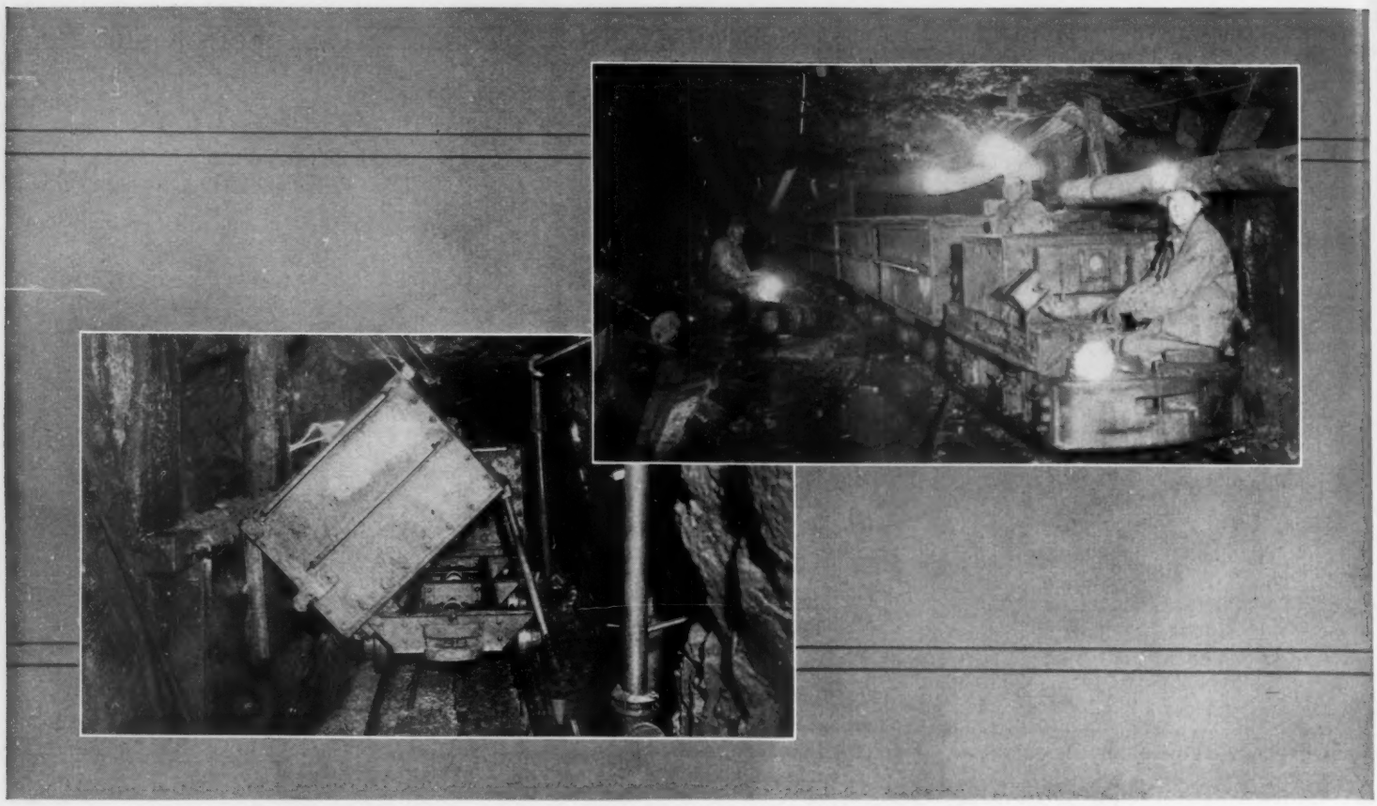
Drifting is carried on during two shifts per day, with two men to the drilling crew. Holes are placed from column or crossbar. Top heading holes are drilled from a set-up on top of the muck pile. After the muck has been cleaned away the bar is set up below, and the round finished. The ground stands without timbering. Drifting progress is from 250 to 300 feet a month. On the main level, mucking is done with a Nordberg-Butler Shuveloader, and a 5-foot round is loaded in three to five hours. Mucking is done by hand on the upper levels. Raises are driven by a crew of two miners and a helper—about six hours being required for drilling. Two Ingersoll-Rand R-51 self-rotating "Stopehamers" are used at the same time. Two sets of 5-foot timbers are placed in eight hours. About 80 feet of raise progress a month is made with one crew.

All stoping is done by the shrinkage method. Chute holes are raised from the drifts on about 20-foot centers, and about 15 feet above the track they are widened out, connected, and stoping operations started. Raises are used for manways and for ventilation where the ore is continuous between two raises, otherwise a manway is carried up in about the middle of the stope. All stoping is done with Ingersoll-Rand R-51 "Stopehamers". Each drill is manned by a machine man and a helper. The principal work of the mine is done under contracts.

A 200-foot tramway tower.

Equipment has been provided throughout the mine to handle readily large pieces of ore from the stopes, thereby eliminating the usual costly practice of bulldozing. This calls for liberal chute openings, large and sturdy mine cars, and an ample primary crusher. Transportation on the main level is by a Goodman 5-ton storage-battery locomotive and 60-cubic-foot round-bottom cars. A rotary dump, shown in two of the illustrations, dumps the cars above the primary crusher. The use of swivel couplings, having axes coinciding with the axis of the dump, permits cars to be dumped without uncoupling. A General Electric 3½-ton storage-battery locomotive and 70-cubic-foot side-dump cars are used for hauling on the 300-foot level, where an air-lift is used for dumping.

The crusher plant has a capacity of 80 tons an hour when breaking to ½-inch size. Ore from the rotary dump falls into a pocket leading to the primary crusher, a Telsmith 16A, which breaks the material to 2½-inch size. It then is carried by a belt conveyor to a Traylor vibrator screen, which separates out particles up to ½ inch and delivers the oversize to a Symons cone crusher. The product of the second crusher, together with the fine material passed by the screen, is conveyed a few feet to a storage stope of



Two underground scenes in the mine. Above—Electric locomotive and cars on the 300-foot level. Below—Dumping a 70-cubic-foot car on the 300-foot level by means of an air cylinder.

750 tons capacity. Ore is drawn from this as needed into gable-bottom cars and hauled to the tramway loading pocket by a Goodman 3-ton storage-battery locomotive. The cars are automatically dumped. Most of the crushing is done at night.

Compressed air is furnished by a 2,000-cubic-foot-per-minute compressor which is direct connected to a 250-hp. synchronous motor. The unit is equipped with 5-step regulation. An 8-inch air main, supported high on the side wall, enters the main drift. Four-inch branch lines are carried up through the raises as required. Casing pipe, with Dayton or Dresser couplings, is used for all air lines, and it affords substantial economies in first cost and installation.

The mine blacksmith shop, adjacent to the compressor room, is completely equipped for repairing rock drills and for general mine blacksmith work. Drill steels are reconditioned in an Ingersoll-Rand No. 34 sharpener, which often handles more than 500 pieces of steel in a day.

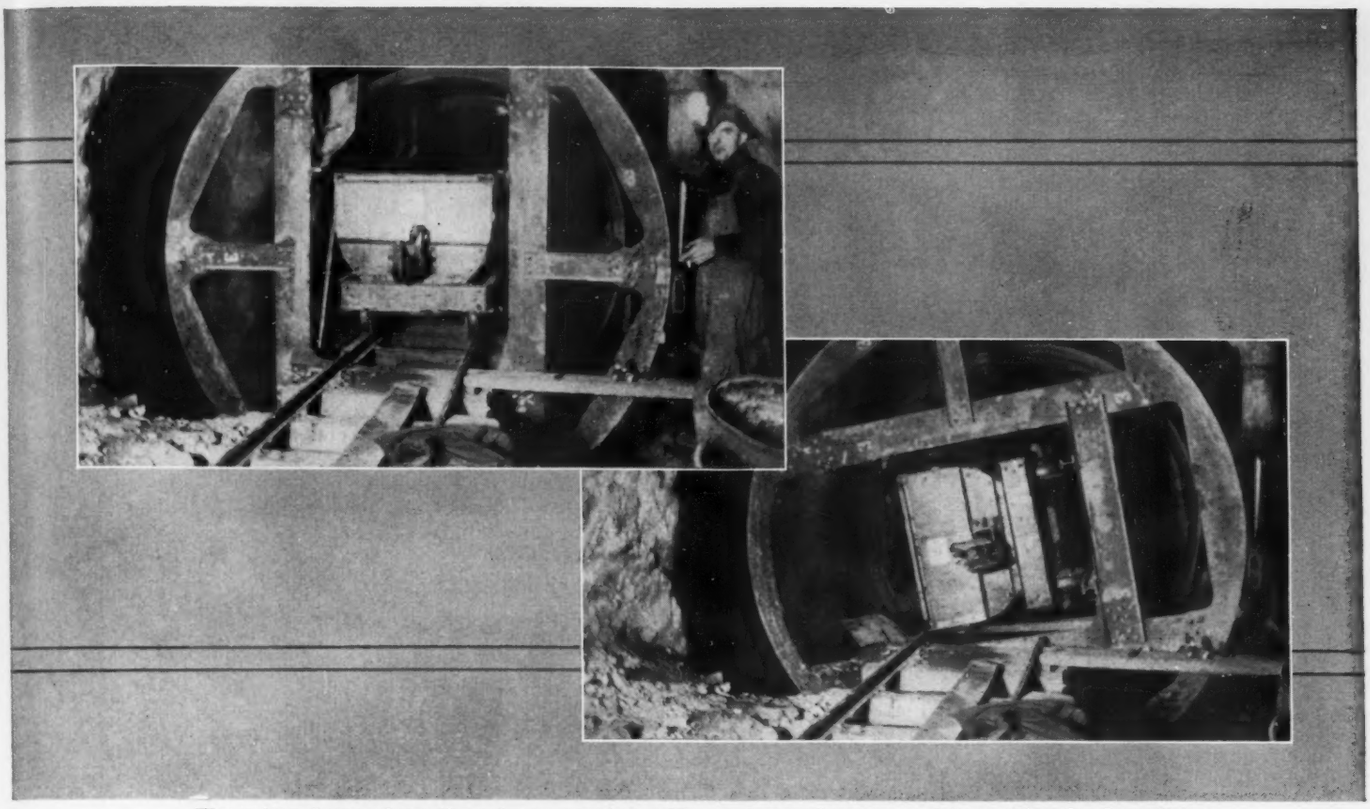
The aerial tramway is the finest ever erected in that section, which has known many such systems. It is 10,000 feet long and has a capacity of 80 tons hourly. The difference in altitude between the upper and lower terminals is 1,400 feet. It descends 800 feet in a horizontal distance of 2,500 feet just below the mine, then flattens out and follows an easy grade to the mill, which is located two miles from Silverton on the main road between that town and Eureka. The use of steel instead of the traditional material—that is, wood—for towers permitted long spans and fewer towers. More important, it added to the strength, service life, smooth operation, and safety of the tramway.

Track cables, which are supported at each tower and which, as the name implies, form a track on which the suspended buckets travel, are of semi-lock pattern and of 1¼-inch diameter. This cable is made up of three sections longitudinally, and each section is anchored at both ends. As each bucket reaches a tower it is transferred smoothly to the walls of a grooved rail to eliminate anvil effect and to prolong the life of the cable. The traction cable, which draws the buckets clamped to it, is a ⅞-inch continuous steel cable which is driven by passing it around two vertical grip sheave wheels. Each wheel is geared through a speed reducer to a 50-hp. motor. Since buckets are normally loaded on the down trip and empty on the return, the line operates most of the time by gravity and the motors act as brakes.

There are 47 buckets, which makes the average interval between them about 425 feet. Each bucket is of ¾ ton capacity and is suspended from a 4-wheel truck. For loading and unloading at the terminals, the buckets are diverted from the cable to a monorail. Buckets are so equipped that they automatically attach to or detach from the traction cable at the terminals. The towers were designed with sufficient clearance to permit the handling of bulky freight. All supplies for the mine, from timbers to heavy motors, are transported on the line.

The upper terminal of the tram is at the ore loading station, which is 120 feet lower than the principal mine portal and buildings. To provide for delivery of up-freight, a 400-foot auxiliary tramway was built. A monorail telpherage system at its upper end permits distribution of materials to various points. Mine timbers are pushed by hand into the timber shed or to mine cars; groceries are taken direct to the kitchen or storeroom; and coal is dumped into bins.

A corner in the underground blacksmith shop.



The rotary dump above the primary crusher. Above—A car of ore secured in position for dumping. Below—The same car being rotated for dumping. Cars can be dumped without uncoupling them.

The main tramway was designed by Fred C. Carstarphen, Denver consulting engineer.

Experience gained during operation of the mill taken under lease in 1928 made it possible to build a permanent mill which is well adapted to the ores and which, accordingly, is showing very satisfactory recoveries of values. The plant was designed by Arthur J. Weinig, consulting metallurgist, who directs the experimental ore-treating plant at the Colorado School of Mines. Although originally intended to handle 300 tons each 24 hours, the capacity now approaches 600 tons. Space is available in the building for installing abundant additional equipment.

The concentration methods employed are tabling and flotation. Wilfley tables at three points make lead concentrate. By flotation is made a copper-gold concentrate together with an iron-copper concentrate which is reground and floated for copper. Reagents used are xanthate, pine oil, and lime. The concentrate is trucked to Silverton and shipped by railroad to Durango for smelting. A building adjacent to the mill houses the general offices and the assay office.

It is significant that the Shenandoah-Dives property has been placed on a profitable basis during a major economic crisis. With its strategic location with reference to a large, persistent vein system; its modern, first-class equipment; its economical methods and thorough organization; its proved large reserves of low-grade ore; and the ever-present possibility that future explorations will here and there uncover some high-grade deposits, every indication points toward many years of successful mining. The Shenandoah-Dives is already regarded as one of the outstanding mines of Colorado. Its consistent operations are proving a distinct boon to Silverton, which looks forward hopeful that the rugged mountains that surround it will some day again pour forth a steady stream of gold and silver from almost every gulch.

Offices of J. W. Oldham, president, and Charles Charpiot, secretary-treasurer of the company, are in Kansas City. As general manager, Mr. Chase directs operations at Silverton. James A. McKay is mine superintendent, Howard Histed is mine engineer, E. L. Garrison is day foreman, and P. M. Mosier is night foreman. T. R. Hunt is mill superintendent and L. H. Karau chief clerk and purchasing agent.

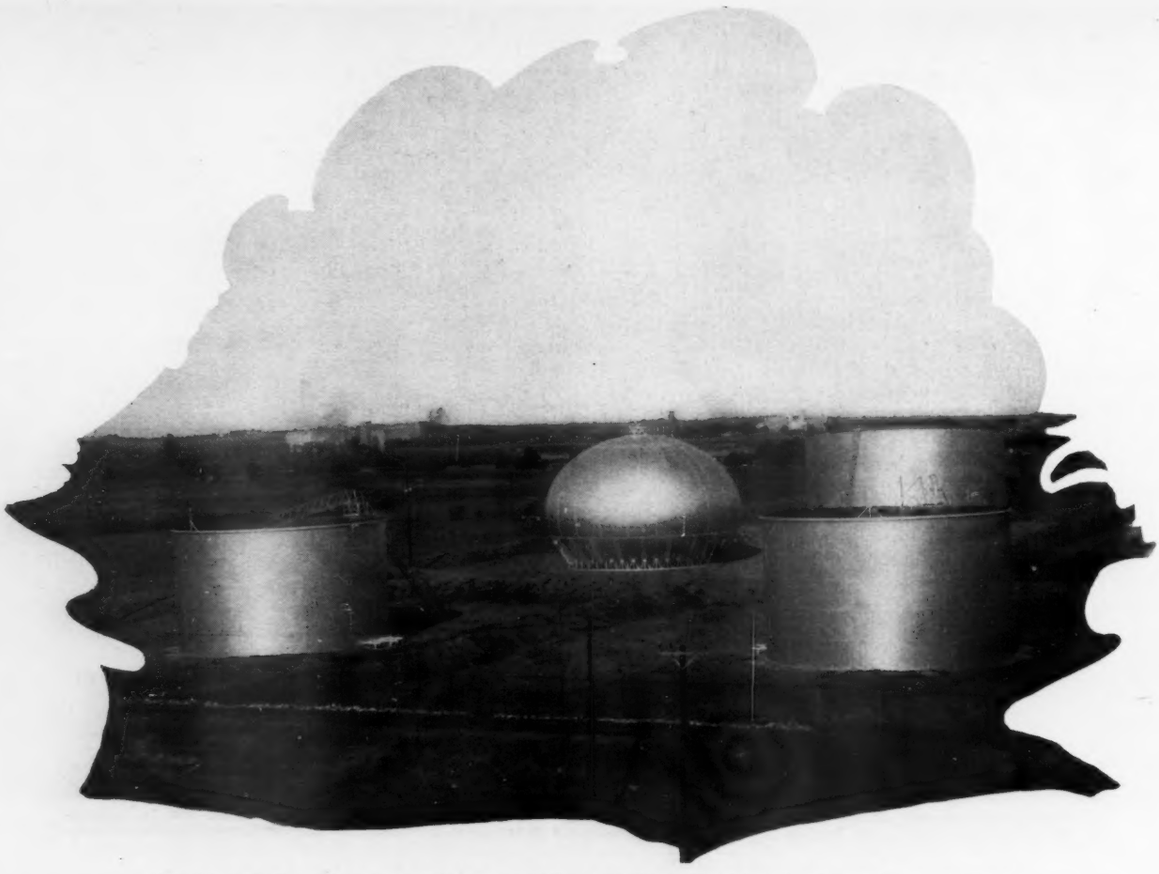
Putting waste over the dump with an air hoist.

Note—The author wishes to make acknowledgment to Messrs. Chase and Histed for much of the material on which the foregoing article is based.

GERMANY USES ALUMINUM ALLOY FOR TRANSMISSION LINES

AN ALUMINUM alloy, known as "Aldrey", is finding increasing application in Germany for electrical purposes, especially for transmission lines, according to reports from Hamburg. The metal analyzes 0.25 to 0.3 per cent iron, 0.4 to 0.7 per cent silicon, and 0.3 to 0.5 per cent magnesium, the remaining percentage being aluminum. Unlike most such alloys, it contains no copper or zinc. It has a tensile strength of about 44,000 pounds per square inch; a specific gravity of 2.7; a melting point of 1,202° F.; an electrical conductivity equal to that of copper; and can be bent, drawn to the finest gages, and pressed or welded.

"Aldrey", it is claimed, is less subject to fatigue than are the other metals used in electrical transmission; and the fact that it is highly resistant to corrosion makes it especially applicable for lines near seacoasts.



Floating roofs protect the oil in three of these tanks against loss by fire and evaporation. The pressure tank in the center is known as a Hortonspheroid. Such holders must be carefully erected and riveted if they are to retain their proper curvature.

Floating Roofs on Oil-Storage Tanks Check Evaporation Losses

A. M. HOFFMANN

ROOFS on oil-storage tanks are not just a covering to keep out rain and snow or to shade the inflammable contents. Their principal purposes are to prevent fire and evaporation, which, until the introduction of the tank with the protective top, were fruitful sources of loss to the industry.

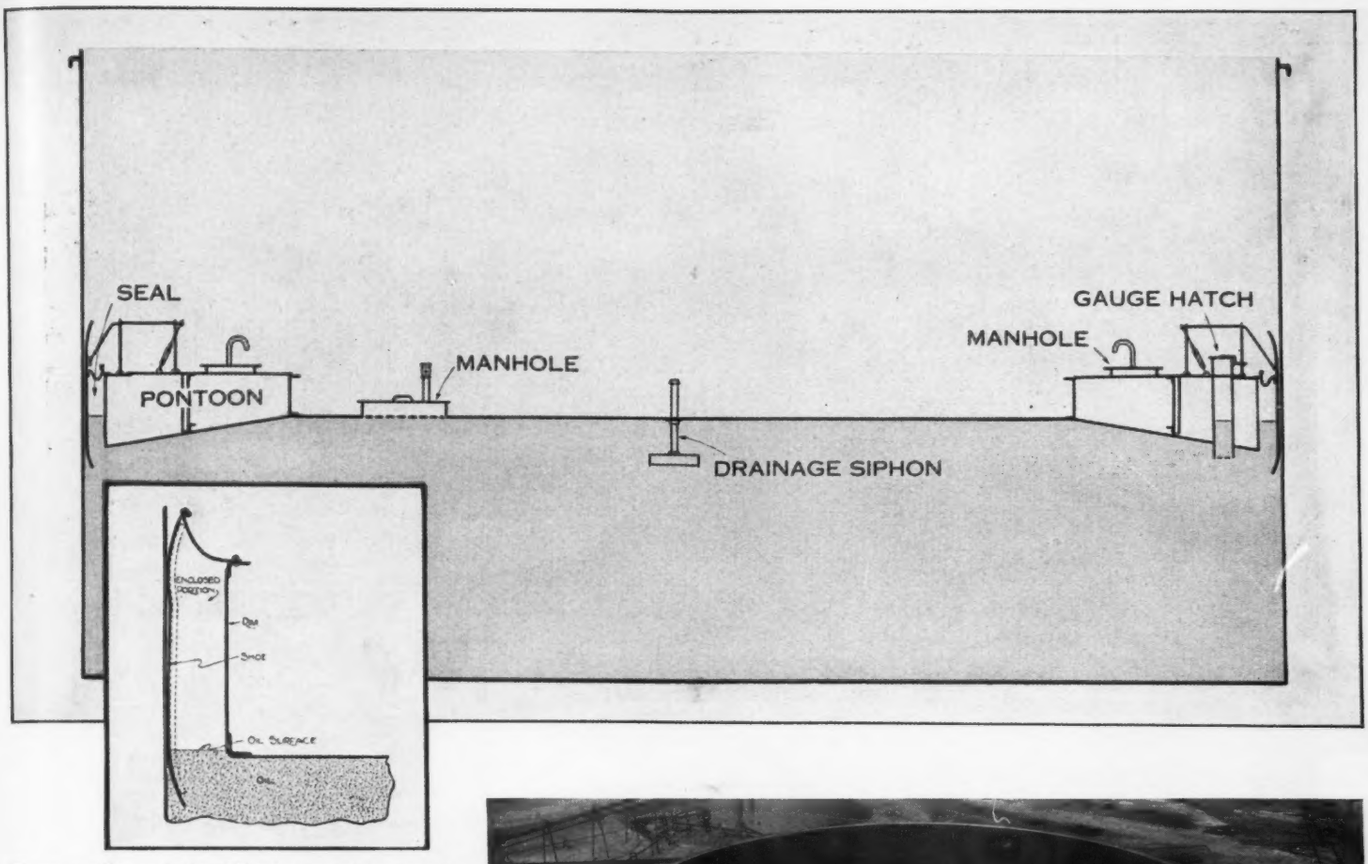
Crude oil and its derivatives such as gasoline, naphtha, etc., are known to evaporate rapidly when exposed to the atmosphere. Just how rapidly can be more fully appreciated when it is known that Government experts estimated about twelve years ago that the volume of gasoline evaporated the country over equaled one-thirtieth of the total annual production—taking into account only the evaporation occurring from the time the oil is stored in the tanks until it is drawn off for pumping through pipe lines. In the Mid-Continent field, alone, this wastage amounted to approximately 122,000,000 gallons every twelve months. But besides a decrease in the volume of the oil, exposure to the air also impairs its quality—gasoline, for example, having a lower specific gravity after being held for a while in an ordinary tank that permits evaporation.

As the oil industry grew with the demand for more and better gasoline to drive the annually mounting number of cars and trucks, the problem of finding some means that would considerably lessen heavy evaporation losses and also prevent fire became more acute. Different things were tried to bring about the desired results, and among them a floating roof. This proved so effective that oil companies the world over have been quick to recognize the advantages offered by it in the form of increased safety and large savings.

Among the pioneers in this field was the Chicago Bridge & Iron Works, which has been largely instrumental in bringing the Wiggins type of roof to its present stage of development. Late in 1923, that company arranged with John H. Wiggins, who had formerly been identified with the United States Bureau of Mines, for the construction of a roof according to his design. The floating roof of that day has in the meantime undergone many improvements.

Generally speaking, there are two types of floating roofs, and each of these has a flexible seal between its edge and the shell of the tank to prevent the escape of vapor. One is known as the open-deck or pan type, and consists of a single layer of steel with a rim around the outer edge. The other is the pontoon roof which has been lately devised and is so called because it has a ring of annular pontoons around the edge. This insulating air space aids materially in reducing the temperature of the seal as well as of the liquid in the tank. While built in a continuous ring, the pontoons are separated by bulkheads so that each acts as an independent unit.

The flexible seal, as an accompanying diagram shows, is composed of a ring of tall shoes that is held against the shell of the tank by a system of hangers. These shoes form a long sliding contact with the shell. While the seal is not airtight, it does effectually check loss through evaporation, because the open-

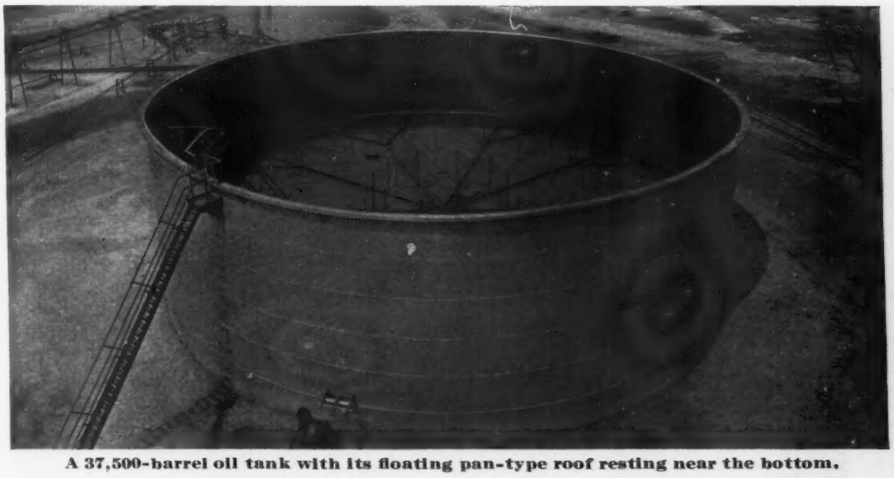


Cross section of the Wiggins pontoon roof with details of the seal for a pan-type roof shown in the insert.

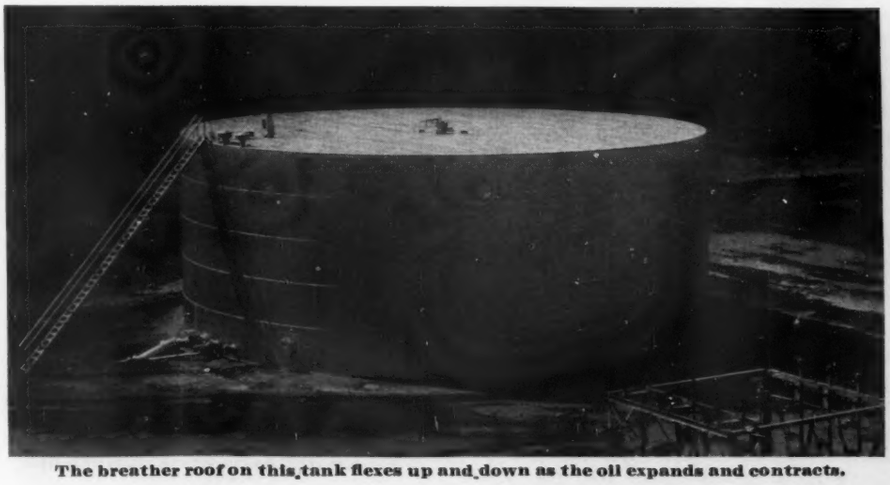
ing between the shoes and the tank is a fairly long, narrow slot that keeps out circulating air. Therefore, the air immediately above the free surface of the oil remains still, thus preventing continued evaporation. There is a small gas space between the shoes and the roof. This gas space, as well as the oil below, is insulated by the contiguous ring of pontoons.

Roofs are not ordinarily thought of in the sense of an operating mechanism; but floating roofs do operate. When the tank is empty, the top rests on supports, and may be held any distance away from the bottom for cleaning, inspecting, etc. As oil is pumped into the tank the roof begins to float and to rise with the contents. Usually, a rolling ladder is provided so that workmen or gagers can go down on the roof when the tank is partly filled; and to take care of any water that might accumulate on top of it, the roof has a drain at the center.

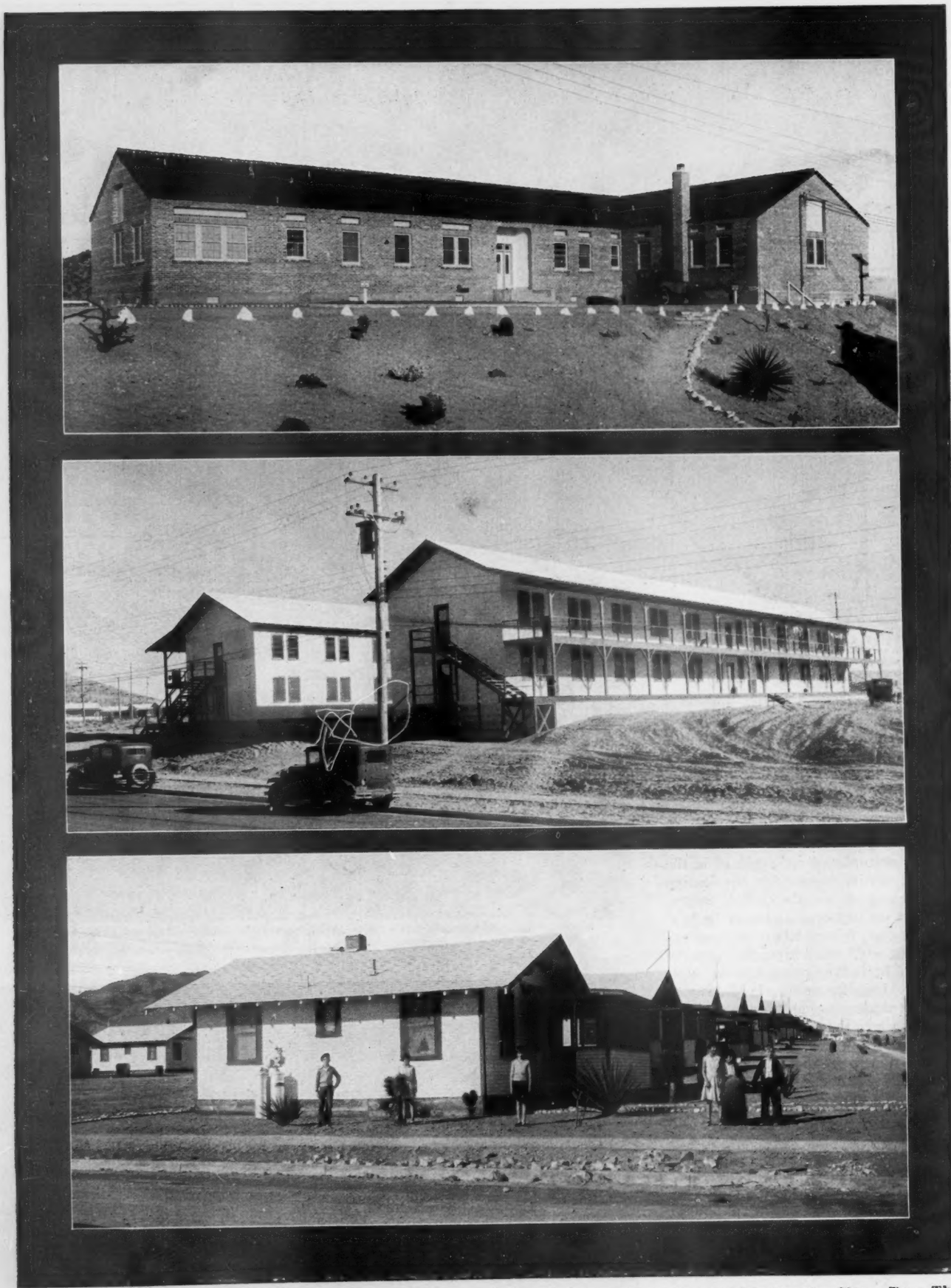
Where oil is stored in tanks for relatively long periods, evaporation is prevented by what is known as the breather roof. It is of steel; very nearly flat; supported by special framing inside the tank; and fastened only around the top of the tank shell. The roof can therefore flex up and down like a huge diaphragm—the rise at the center of a tank with a diameter of 117 feet amounting to from 24 to 26 inches. This action takes care of volumetric expansion and contraction in the tank, and thermal breathing losses are stopped because no vapor escapes.



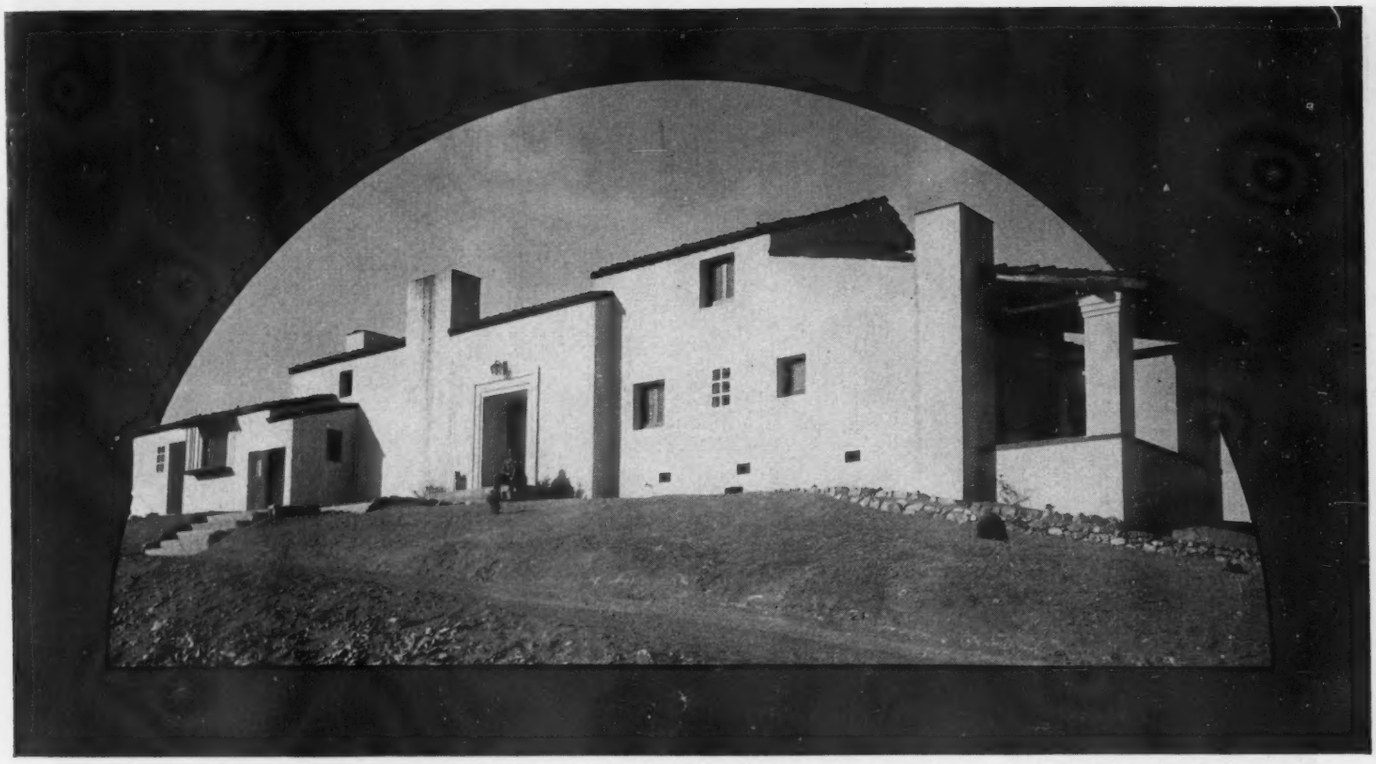
A 37,500-barrel oil tank with its floating pan-type roof resting near the bottom.



The breather roof on this tank flexes up and down as the oil expands and contracts.



Three views of typical structures among the 475 buildings erected by Six Companies Incorporated in Boulder City. Top—The $50,000 hospital. Center—Two of the 172-man dormitories, of which there are eight. Bottom—A row of 3-room houses for married workers and their families.



This attractive Spanish-type building is the home of the directors of Six Companies Incorporated during their frequent visits to the work. It also serves as a guest house.

Construction of the Hoover Dam

*How the Contractors Handled the Huge and Costly Program of Preliminary Work**

C. H. VIVIAN

DESPITE the unprecedented size of the Hoover Dam contract, the multiplicity of operations involved, and the comparative isolation of the site, Six Companies Incorporated organized its forces and entered upon its huge task in surprisingly short time. Formal notification by the Government to begin work was not given until April 20, 1931, following the actual signing of the contract by Secretary Wilbur of the Department of the Interior. The contractors did not stand on ceremony, however, and little more than a week after the opening of bids at Denver, on March 4, Supt. F. T. Crowe was on the ground recruiting a labor crew to carry on the initial stages of the 7-year job and at the same time making ready for subsequent operations. First of all he opened an office at Las Vegas, Nev., roughly 30 miles from Black Canyon. Then he visited the site where the construction town of Boulder City was to rise and started a battalion of men building quarters for the army of workers that was to follow.

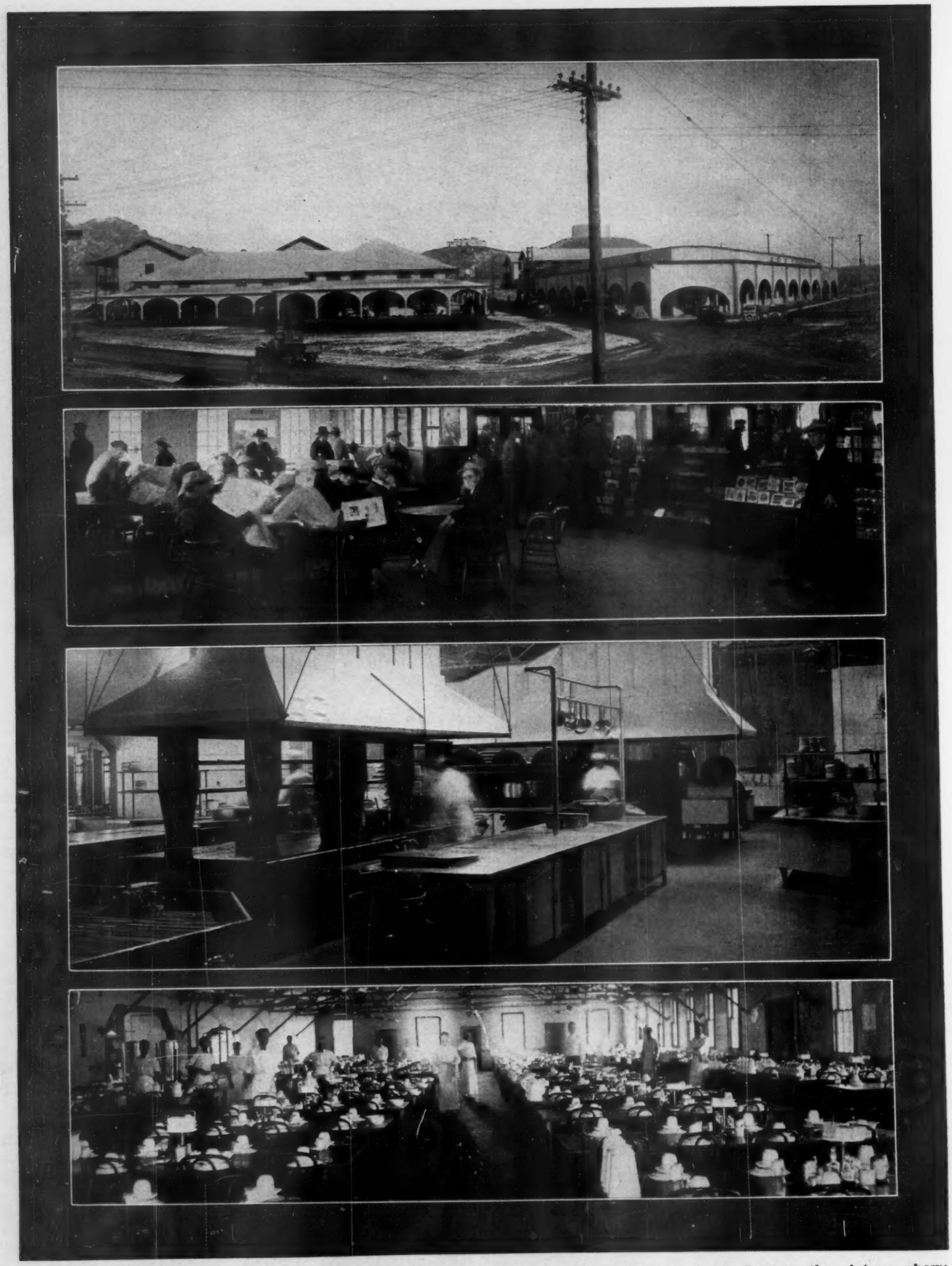
The speed with which Six Companies Incorporated inaugurated work is characteristic of the zeal and industry which have since been shown. At the very outset, the gigantic undertaking was resolved into its various major factors and every phase of the work that could be started was got underway with the least possible delay. By June, 700 men were at work, and the payroll was $100,000 monthly. Almost over night the desert quiet was transformed into teeming activity. A 3-shift day and a 7-day week were put into effect as soon as the working forces had been fairly organized, and that schedule was adhered to month after month almost without a break. Neither the sizzling summer heat nor the advent of legal holidays was allowed to slow things up. As a result of this vigorous program, remarkable progress has been made during the first year of operations. If maintained, and there seems to be every reason that it will be, it is bound to bring about completion of the contract well ahead of the time limit set.

W. A. Bechtel, president of Six Companies Incorporated.

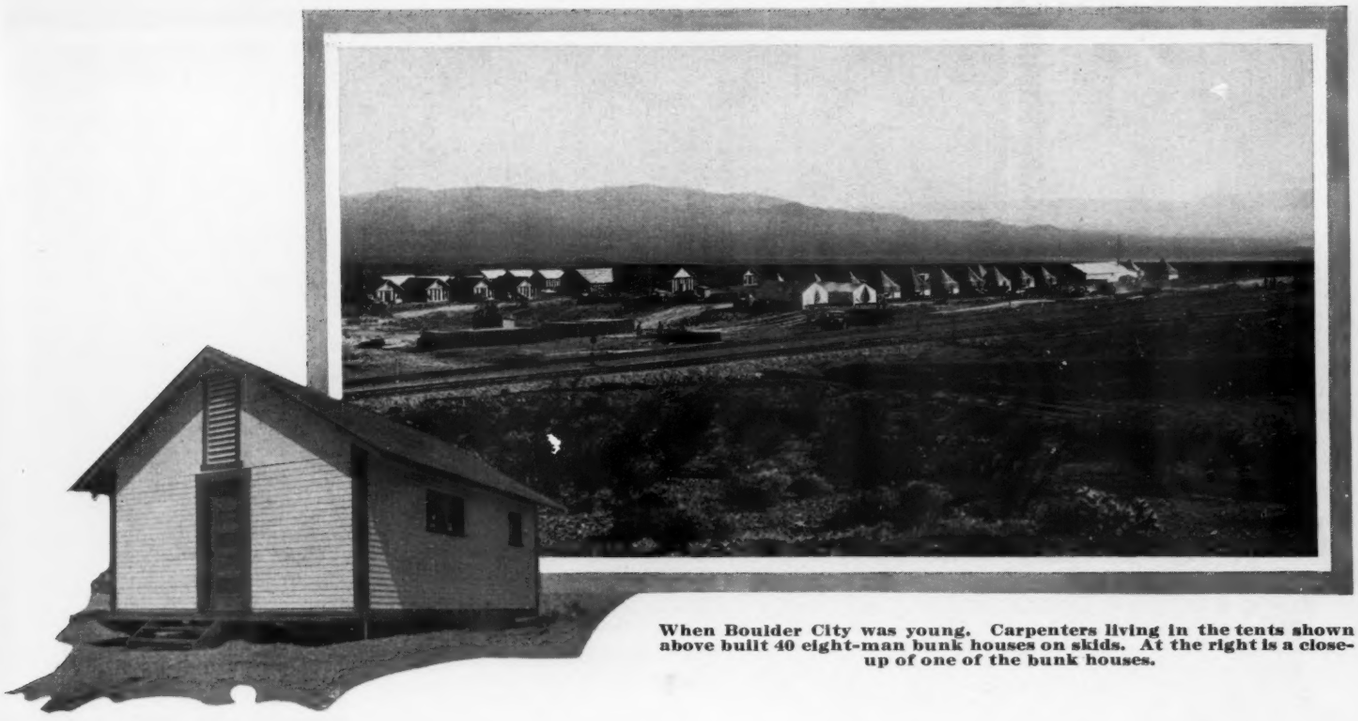
It is safe to say that never before has there been a project which required so much preliminary work before the real purpose of accomplishment could be attacked. While no official figures are available on the point, a member of the Six Companies organization has estimated that approximately $2,000,000 was spent before a shovelful of "pay dirt" was turned over. This huge sum, which had to be expended merely to prepare the way for performing the principal work involved, is in itself sufficient to carry out a complete contract of no mean size.

The advance guard of dam builders was greeted by a desolate region of no buildings and few roads, populated principally by little vari-colored lizards and an occasional jack-rabbit. The arid climate and the sandy soil combine to limit the vegetation to little other than mesquite and cacti, and one might travel mile upon mile without seeing a tree. Roughly 1,400 feet below the general level of this barren expanse, the temperamental Colorado River, red and roily, has cut a serpentine

**Fifth of a series of articles on the Colorado River and the building of Hoover Dam.*



Good food and recreation for employees are considered important by the contractors. From top to bottom the pictures show: the recreation building and, at the right, the department store; a corner in the recreation building; a portion of the spick-and-span kitchen; one side of the 1,000-seat dining hall.



When Boulder City was young. Carpenters living in the tents shown above built 40 eight-man bunk houses on skids. At the right is a close-up of one of the bunk houses.

course. At Black Canyon it is hemmed in by sheer walls of igneous rock 600 feet high: above the canyon the basin widens to a 12-mile span from rim to rim.

From the outset, there was no attempt to compromise with nature. "We must have a place to eat and sleep before we can put men out there", Superintendent Crowe stated. Accordingly, the first plans unrolled were those for a construction camp. The canyon bottom near the dam site was virtually inaccessible at the time except by boats; moreover, it was a veritable inferno in summer. The Government had wisely selected a site seven miles from the river on the Nevada side for a base of operations. Here it was that Six Companies Incorporated pitched camp and formed the nucleus of Boulder City—the fastest growing town America has known since the era of the gold rushes. During the intervening period of less than twelve months, the contractors have spent upwards of $800,000 for the construction of more than 475 buildings, practically every one of which will be torn down as soon as the dam is completed. This because Uncle Sam hopes to mold a model municipality there. Details of its physical and political make-up and the part that the Government is playing in its development will be presented in a later article. It is our present purpose to sketch, in a broad way, the steps that the contractors had to take by way of approaching the main task in hand, and to set down some of the things that were done to bring a measure of comfort to the workmen in a section of trying climatic restrictions.

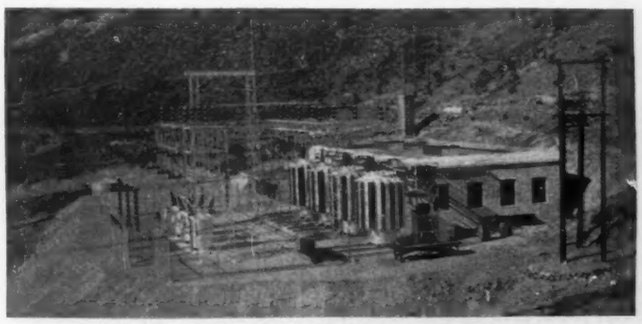
At the time the Six Companies forces appeared on the ground, the Union Pacific Railroad was completing a 22-mile branch from a point near Las Vegas on its Salt Lake City-Los Angeles line to the site of Boulder City. Meanwhile, construction was in progress on both a railroad and a highway extending from Boulder City to the edge of the Nevada canyon wall above the top of the projected dam, the Government having let contracts for these in January.

The building of the 10½-mile railroad was in the hands of the Lewis Construction Company, of Los Angeles, whose bid of $455,509.50 was the lowest of the sixteen submitted. The line traverses a rough section which called for a ruling grade of 3 per cent and a maximum of 5 per cent. Its construction involved the moving of 900,000 cubic yards of earth and 202,000 cubic yards of rock, as well as the boring of five tunnel sections aggregating 1,705 feet in length and requiring the excavating of 26,000 cubic yards of rock. The tunnel work was done by Joe Gordon of Denver. The contract specified completion within 200 days from the beginning of work.

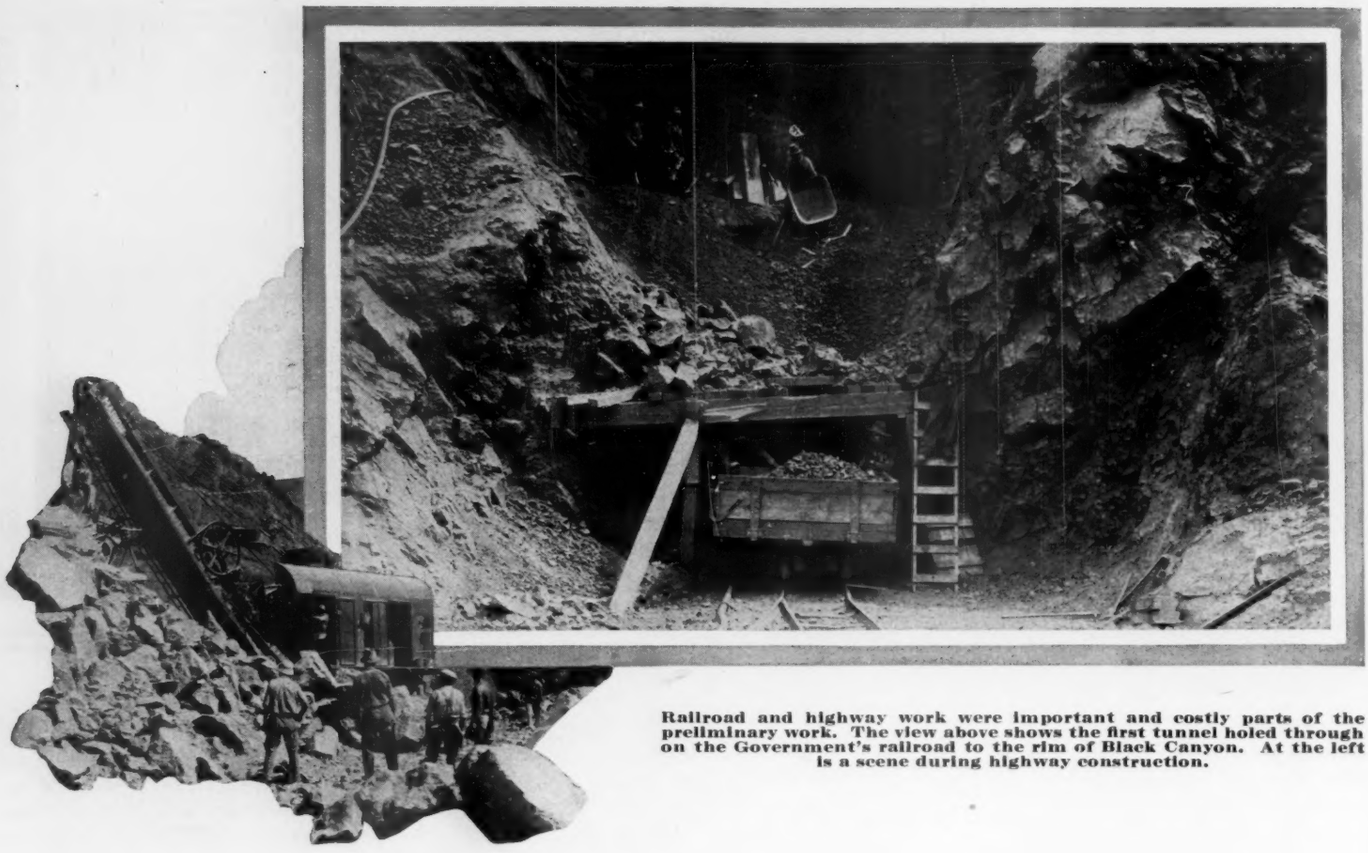
The contract for the gravel-base, oil-surfaced highway, 22 feet wide and 43,972 feet long, was let to the General Construction Company of Seattle, Wash., which gave a subcontract to R. G. LeTourneau, Incorporated, of Stockton, Calif. The work entailed the handling of 107,000 cubic yards of common excavation and 228,000 cubic yards of rock. Incidentally, something of a record was made in getting started on this work.

Two days after the contract was let it had been transferred to LeTourneau, Incorporated. Operations were started four days later, on January 28. On January 30, the Anderson Brothers Supply Company of Los Angeles had facilities ready to care for 100 men. By February 7, fifteen carloads of machinery and equipment had been delivered, including fifteen Caterpillar tractors and two Ingersoll-Rand portable air compressors.

Through the instrumentality of the Government, work was also underway on another very important medium of service to the contractors. This was a transmission line to deliver power to the site from generating stations at Victorville and San Bernardino, Calif., the latter more than 200 miles away. The contract for furnishing power was awarded jointly to the Southern Sierras Power Company and the Nevada-California Power Company. The line, together with a substation near the rim of the canyon on the Nevada side, was designed and constructed by the first-named company at a cost of approximately $1,500,000. Here, again, unusual speed was shown in the face of many obstacles. Despite the fact that a considerable portion of the route was across mountainous country, the 193-mile line from Victorville to the substation was put in place at the rate of 1.45 miles a day, which is said to constitute a



The substation which serves as a distributing center for the many electrical lines.



Railroad and highway work were important and costly parts of the preliminary work. The view above shows the first tunnel holed through on the Government's railroad to the rim of Black Canyon. At the left is a scene during highway construction.

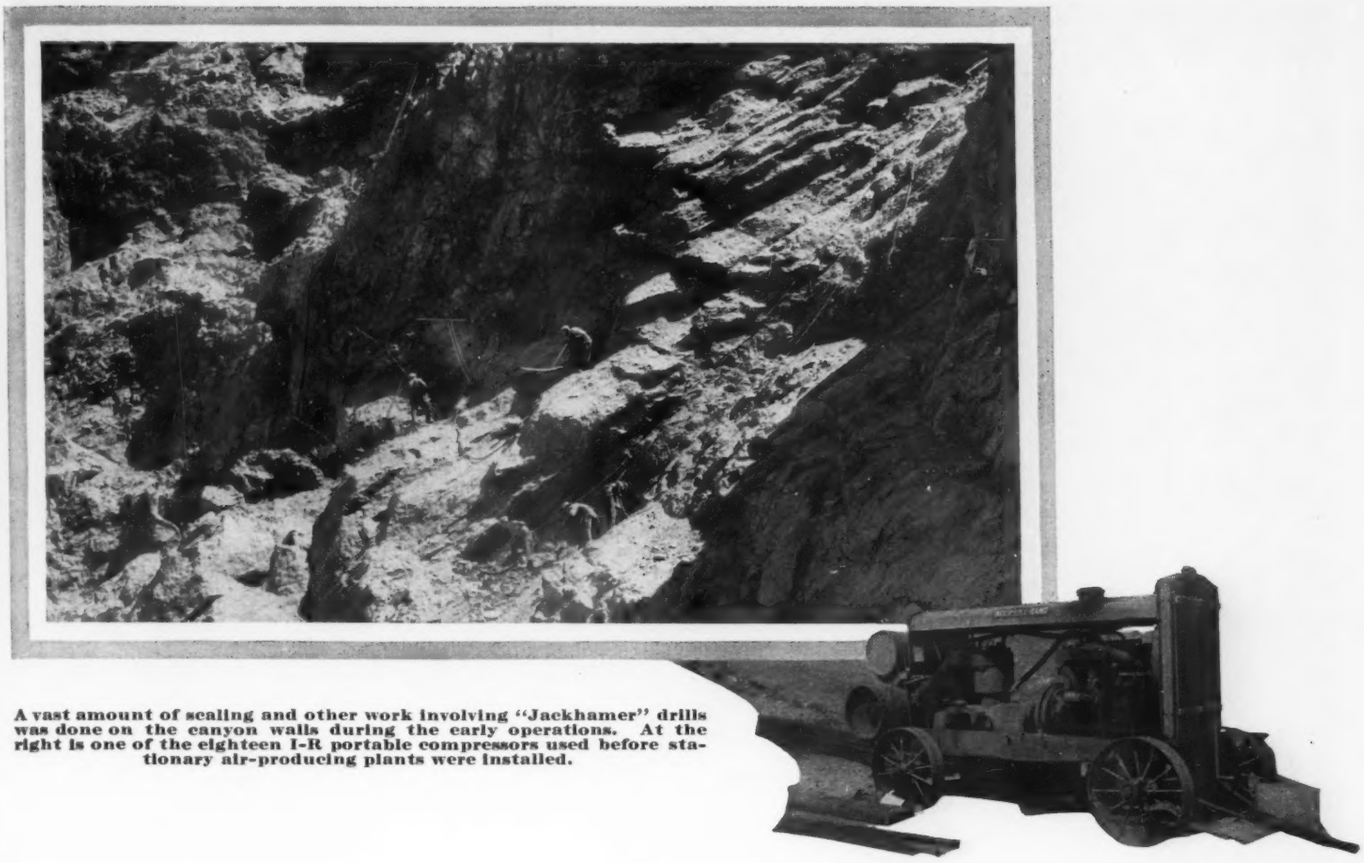
record for such work. Field camps for from 50 to 80 men each were established at suitable intervals, and as many as five of them were maintained at a time. In some cases the trucks that delivered materials and supplies had to make their own roads; and on one occasion it was necessary to let a truck down a steep grade by means of a winch and cable. Construction activities extended over a distance of 125 miles at one time. The line consists of 2-legged, fabricated-steel towers with 34-foot, steel, angle cross arms, spaced seven to the mile. Approximately 5,000,000 pounds of steel and 1,080,000 pounds of aluminum-strand, steel-reinforced cable were used. A telephone line parallels the power line.

Construction of the substation on a high, rocky point having a steep approach was accompanied by difficulties. A compressor to furnish air for excavating the 2,100 cubic yards of rock required to be moved for the placing of foundations was packed up the hillside in sections by burros. Later a temporary switchback road, having grades up to 17 per cent, was built to permit the moving in of construction materials and station equipment. Power was turned on on June 25, beating by several days the time limit of 240 days allowed for designing and building the system. R. H. Halpenny was in charge of design and E. J. Waugh was construction engineer. Field forces on line construction were in charge of C. H. Rhudy; and H. O. Watts supervised the building of the substation. The line is insulated for 132,000 volts, but power is being transmitted at 80,000 volts. A 6.83-mile, 33,000-volt, wood-pole line was built from the substation to Boulder City, and a .73-mile, 2,300-volt line was constructed into the canyon to furnish power to the No. 1 pumping station of the water-supply system for Boulder City.

As previously written, the first concern of Six Companies Incorporated was to provide adequate living quarters for their personnel. In this connection it should be emphasized that the ends to which the contractors have gone to minister to the general comfort and well-being of their employees is without precedent in American contracting annals. In a sense, the Hoover Dam project is not only a construction job but also a sociological venture.

A tent colony, served with water from tank cars, housed the workmen who founded Boulder City. These men quickly put together forty 8-man frame houses, built on skids to facilitate their movement later on. A brigade of carpenters, plumbers, and other artisans occupied these houses as soon as they were ready, and proceeded to erect the contractors' permanent camp—the most extensive array of buildings ever assembled in connection with a construction job in this country. The contract provides that 80 per cent of the contractors' employees must live in Boulder City; and, in laying out the town, the Government allotted certain portions to the contractors for building purposes. A rental of $5,000 a month is paid for the use of this land.

Eight dormitories for single men, each two stories high and capable of housing 172 persons, have been built. They are in the form of a letter H, with shower baths and toilets in the central section. A large, screened porch runs the length of the building on each floor. A unique feature is the provision of individual rooms, 7x10½ feet, for each man. A large building houses the general offices of Six Companies Incorporated, in which are grouped the executive, accounting, purchasing, and engineering staffs. Adjacent to it is a dormitory for unmarried office employees, with one end made into a clubroom. Close to the structures previously mentioned are the mess hall, with a seating capacity of 1,000, and a modern laundry. A separate dormitory is provided for the 75 mess-hall employees. Another large structure serves as a recreation center. It contains billiard tables, a soda fountain, a barber shop, a news stand, and other features. A well-defined recreational and sports program is carried on under the direction of Frank Moran, former contender for the heavyweight boxing championship of the world. A commissary, which is in reality a department store, occupies a large building. Fixtures, built especially for the purpose, and furnishings of the most modern type make attractive the interior, which is divided into sections which retail every conceivable item of merchandise at prices which compare favorably with those asked for similar classes of goods in Los Angeles. All major buildings are equipped with water-washed air-conditioning plants and air-distribution systems which make it possible to cool or heat them as desired. Four central heating plants will be utilized in winter months. Electric water coolers are installed in all principal buildings.



A vast amount of scaling and other work involving "Jackhamer" drills was done on the canyon walls during the early operations. At the right is one of the eighteen I-R portable compressors used before stationary air-producing plants were installed.

Individual cottages, each placed on a 50-foot lot, are provided for renting to married employees and their families. Each cottage is supplied with electricity for lighting, flasks of high-pressure gas for cooking, and fuel-oil stoves for heating. It might be noted here that Boulder City is as near a smokeless town as exists. Up to February 1 of this year 396 such cottages had been built, consisting of 260 two-room and 136 three-room units. There are also eleven 5- and 6-room houses for construction officials and two larger residences for Superintendent Crowe and company executives.

In addition to these buildings are suitably situated warehouses, a garage, machine shop, etc. The machine shop, a steel frame structure, is completely equipped to handle repairs on machinery of all classes used on the job, ranging in size up to locomotives and huge power shovels. Compressed air is furnished by an Ingersoll-Rand Type 20 compressor of 316 cubic feet per minute piston displacement. Included in the shop equipment are several I-R air hoists. There is also an air-operated forging hammer.

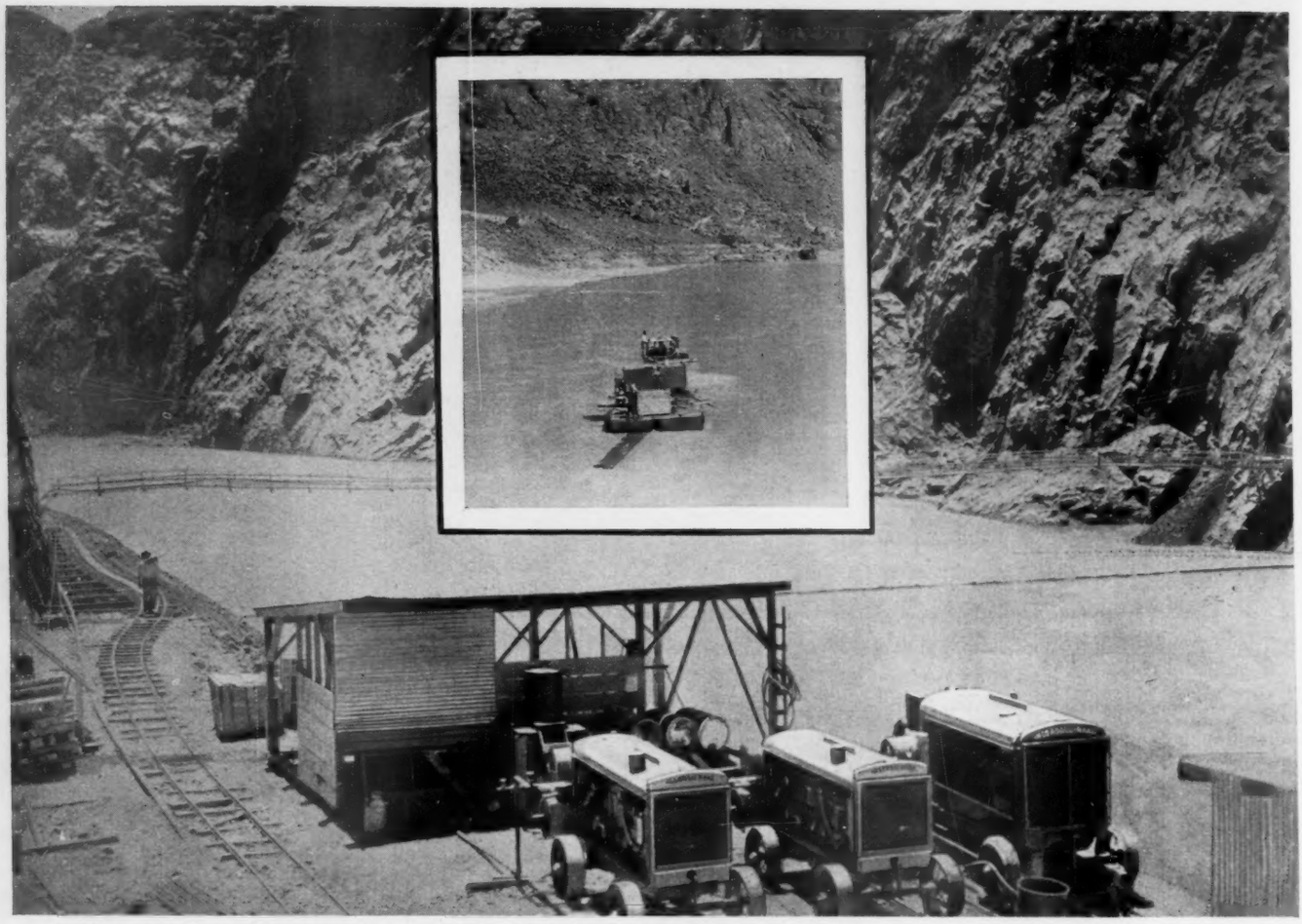
A modern hospital of brick construction and containing $30,000 worth of equipment is designed to become a permanent feature, as it will probably be taken over by the Government upon completion of the contract. It offers every service that can be obtained in the average large city hospital. Twenty beds are now provided, with plans underway to add ten more.

The building program was in charge of the Boulder City Company, a subsidiary organized to direct feeding, housing, and transporting operations. V. G. Evans serves as its manager. George de Colmesmil of San Francisco was the architect. With a few exceptions the buildings have frames of wood, with stucco on the outside and wall board on the inside. Roofs are of asbestos shingles.

The high standard of food served has occasioned comment by all who have visited the job. The mess hall is undoubtedly the finest of its kind ever built for similar purposes. Two large dining rooms, equipped with facilities that savor more of a high-class restaurant than of a contractor's camp, are arranged on either side of a commodious kitchen that is outfitted in the most up-to-date manner. Ingenious machines to aid and improve the preparation of meals abound. Ranges fired by electricity, oil, and gas are available for cooking. Refrigerating rooms are provided for the preservation of meats, vegetables, and other foodstuffs. Incoming supplies are delivered direct from railroad cars or trucks by monorail.

The mess hall is operated under contract by the Anderson Brothers Supply Company, an organization of vast experience in shipyard and movie-location feeding. The finest foods obtainable are served, and there is a wide choice at each meal. Milk—500 gallons of it a day—comes by truck 80 miles from a 160-acre farm which was purchased especially as a source of supply. Last Thanksgiving the dam workers consumed, among other items, 2,400 pounds of turkey, 300 gallons of oyster soup, 300 pounds of cranberries, 760 pies, half a ton of plum pudding, and a quarter ton of candy at the principal meal. Everybody, from the highest executive to the lowliest laborer, eats the same food in the same dining room. Meals are served at six separate times during the 24 hours to accommodate the men on the various shifts. Workers going down to the canyon carry with them a lunch which they select themselves in cafeteria style. An auxiliary camp is maintained at Cape Horn, two miles above the dam site on the river's edge. Six dormitories, each accommodating 80 men, a mess hall, commissary, and recreation room are provided there. They are similar in construction to the buildings at Boulder City.

The building program which has been described extended over a period of many months —in fact, is still going on. Principal structures were, however, erected with great speed, and by the end of the summer accommodations were available for 2,000 men. But it should be remembered, that while the camp in its finished state will eclipse anything of its kind previously built, it lacked many things during the early months of the construction period. With the thermometer registering more than 100° in the shade for days at a time, living conditions were necessarily hard. The chief handicap was the absence, through no fault of the contractors, of an adequate water supply. Consequently, a bath was a real luxury. Then, too, the cooling system for the buildings had not yet been placed in operation. Despite these and other shortcomings, which affected alike the highest and the lowest, the spirit of the great majority of the men was admirable. The fine coöperation which was



A battery of I-R portable compressors supplying air for beginning one of the four diversion tunnels. The insert illustrates how these machines were floated down the river to points of work before roads were built.

shown by the labor force during this pioneer stage of activities was one of the primary reasons that the contractors were able to "get the jump" on the job in hand. Many a disposition which was sorely tried was helped over the rough spots by the knowledge that Six Companies Incorporated was doing all that was humanly possible to provide a maximum of comfort and convenience at the earliest possible moment.

Even while housing activities were in their infancy, the contractors plunged into the task of opening up operations in the canyon. This involved many things. The whole method of attack had to be decided upon, and an organization set up to handle each of the countless phases in its turn and to coördinate all of them. Surveys had to be run and plans drawn. Equipment of every conceivable kind, running from nails to trucks, had to be purchased and got on the job as quickly as practicable.

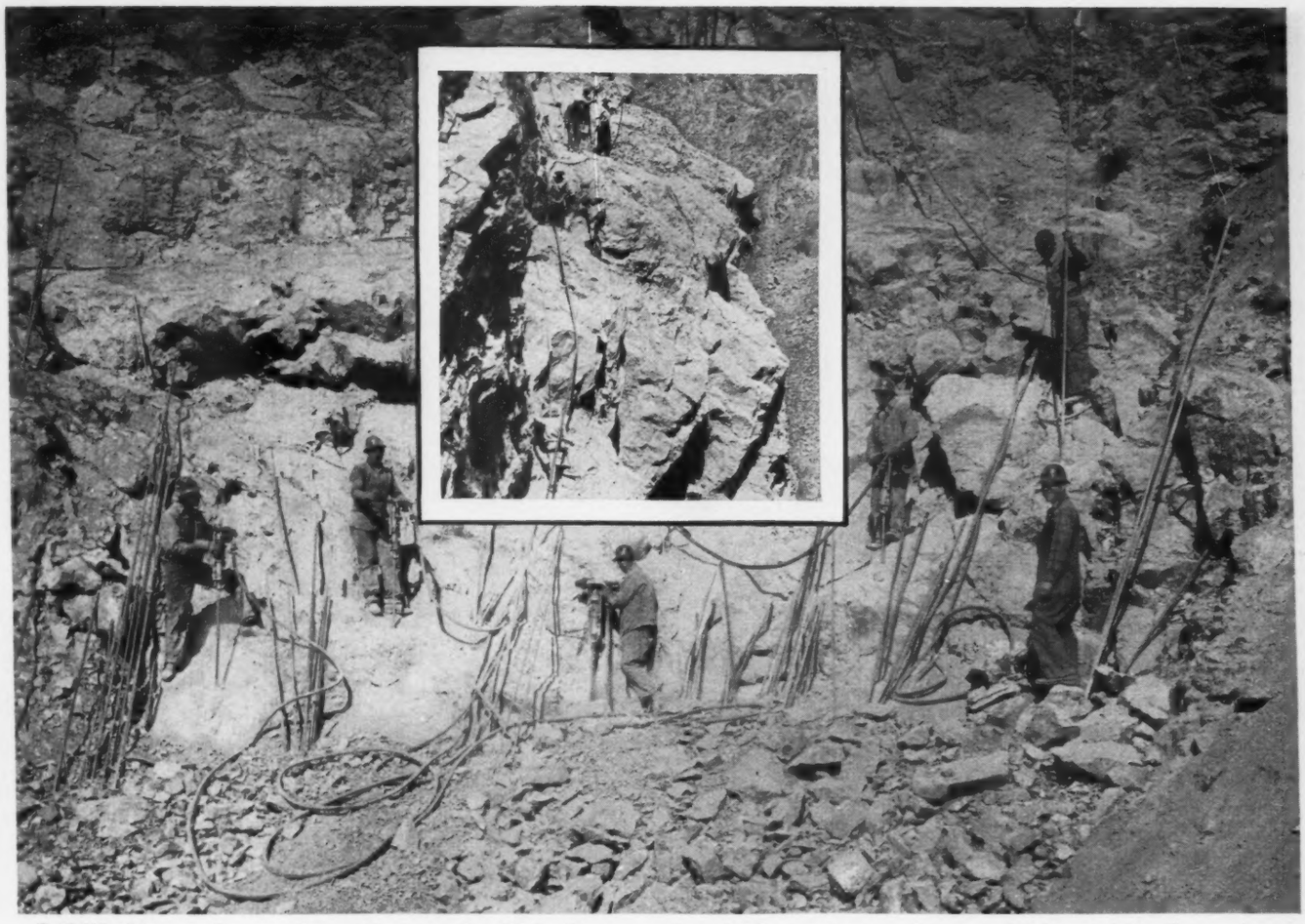
Of immediate concern was the matter of making the river bottom accessible to men and machinery. A 2-mile highway had to be hewn from virtually solid rock to connect the end of the Government road with the water level at a point near the site of the diversion tunnel outlets on the Nevada side, about half a mile below the dam site. At the upper end of the canyon, Hemenway Wash provided a natural approach to the river at a point some two miles above the dam site. From there a road, again mostly through rock, had to be constructed downstream along the base of the cliff to give access to the sites of the upper portals of the diversion tunnels on the Nevada side. Some 30 miles of power lines had to be run from the substation to various points in the canyon to serve electric shovels, electric-driven compressors, pumps, tunneling machinery, etc., and to furnish current for lights within the tunnels and outside flood lights for night work. A number of suspension foot bridges had to be thrown across the river to provide means of reaching the Arizona side with men and materials.

Location surveys had to be run and work started on some 21 miles of standard-gage railroad to connect the Government line with various portions of the work. The line takes off of the Government railroad to the dam site about half way from Boulder City and runs by a winding route, to secure grade, to a point in Hemenway Wash designated as Junction City. Here, at an elevation of 1,015 feet—75 feet above the high-water line of the reservoir that will be created by 1936—will be located the gravel screening and washing plant and the stock pile of aggregates for the concrete that will go into the dam. From Junction City a branch extends upstream to the Arizona gravel deposits and another branch downstream to reach the dam site at an elevation of 720 feet. The last-named section will deliver concrete for pouring the first stages of the dam.

When concreting operations are at their height, this railroad will carry a volume of traffic heavier than that on any main line in the country. Just for transporting the 5,000,000 cubic yards of gravel that will go into the concrete for the dam it will require the equivalent of a 1,300-mile train of freight cars each loaded with 100,000 pounds. Sixteen miles of grading on this railroad work was contracted to the John Phillips Company, and the track laying was contracted to Shannahan Brothers. Six Companies forces undertook the building of the 5-mile section from Junction City to the dam site. Two miles of this work was in the solid rock of the canyon wall, and much of it in tunnels or half tunnels.

Another phase of the work which was started early was the scaling of loose or projecting material from the canyon walls. This cleaning off was done not only to clear sites for the numerous tunnel and adit openings but also as a measure of safety to protect workmen in the canyon bottom.

Compressed air played a vital part in essentially all these pioneer aspects of the construction. At one time eighteen Ingersoll-Rand Type 20 and Type XL portable compressors were in service by Six Companies Incorporated. Before the road reached the



S-49 "Jackhamers" excavating at the base of a cliff in the canyon for a bridge anchorage. A group of "cherry pickers", carrying on their hazardous task of scaling a canyon wall, is shown in the insert.

canyon bottom, barges were employed to float some of these machines downstream from a landing at Hemenway Wash to suitable locations. Incidentally, water transportation has solved the problem of reaching the many points of work which are inaccessible by roads. The contractors early put into service a fleet of motorboats which continue to be of great assistance and which likely will be used to a considerable extent throughout the life of the contract.

"Jackhamers" were indispensable tools in aiding the highway, railroad, and scaling operations, and later on in facing openings for the four diversion tunnels. The drill selected for all these purposes was the Ingersoll-Rand Type S-49.

With the varied activities enumerated in progress and many other divisions of the work being started, the intensity of operations that prevailed can hardly be comprehended. During September, 1931, approximately 50 tunnels were in various stages of completion. Meanwhile, much Government work, which will be described in a later article, was also being vigorously prosecuted.

A yacht of reinforced concrete throughout and carrying 430.5 square feet of sail has been built in Sweden. Her shell ranges from 0.3 to 0.4 inch in thickness.

NEW DEVICE SAFEGUARDS SHIPPING IN FOGGY WATERS

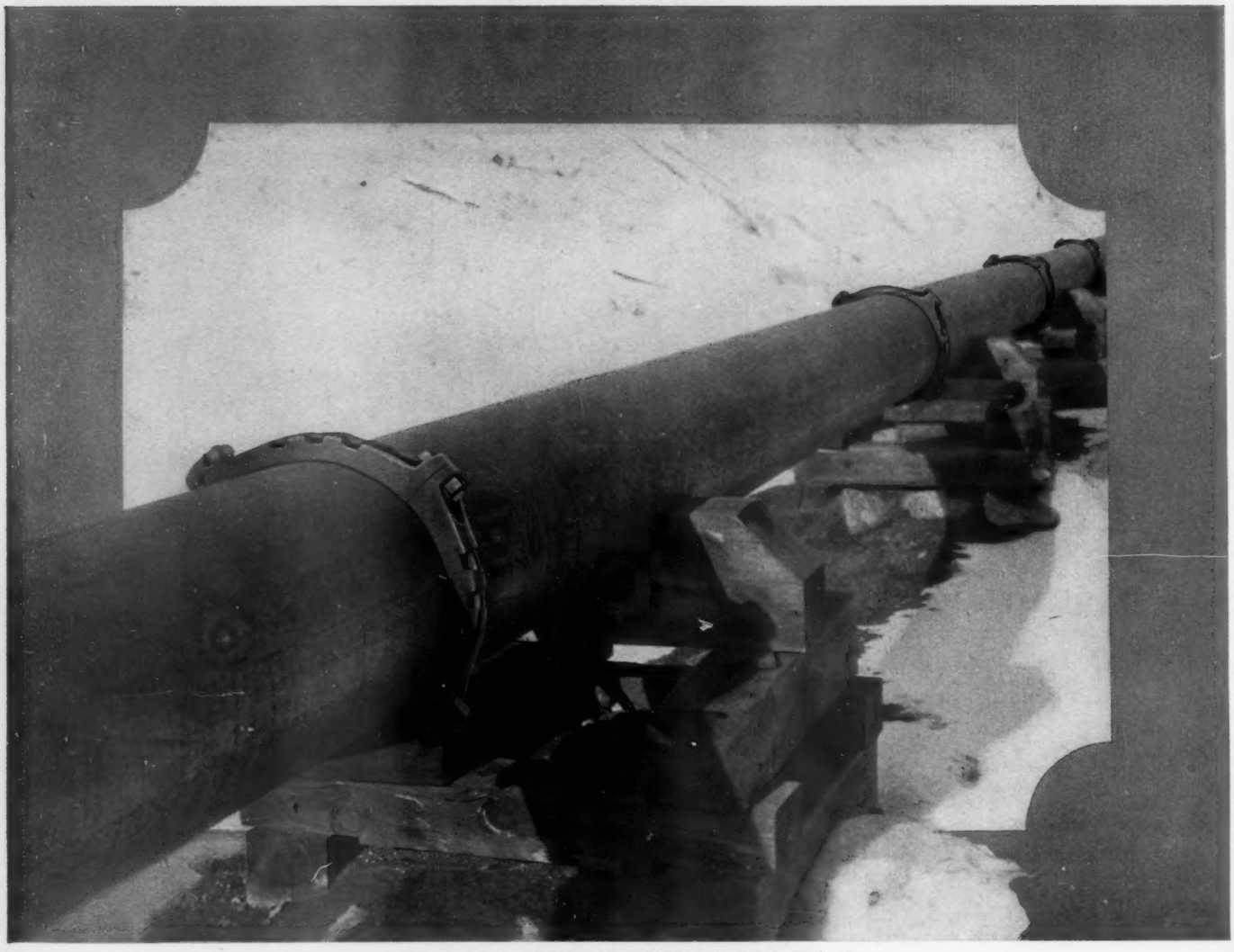
"BULLETS of sound", that bound back to the spot whence they came, have been used successfully in fog-enveloped waters to safeguard shipping. The device that projects the "bullets" from a vessel is termed a sonic locator, and is a direct outgrowth of the sonic altimeter, both products of the General Electric Company. As the sonic altimeter tells an airplane pilot how far he is above the ground, and indicates the presence of mountains, hills, or buildings, so does the sonic locator on shipboard warn the navigator in ample time to avert disaster that he is approaching another craft, a buoy, or land.

The apparatus consists of a sending megaphone and a pair of binaural receiving megaphones mounted in a revolving framework inside the cabin or listening post. The sending megaphone is provided with a 3,000-cycle compressed-air whistle; and the receiving instruments terminate in ear pieces. When the blasts from the whistle impinge upon any object, the sound rebounds—the number of seconds elapsing between the instant the whistle is blown and the echo is heard determining the distance of the object from the boat.

In its finished form the sonic locator includes a motor-operated whistle valve and a timer. By this arrangement a blast is sounded automatically every five seconds and, with each blast, a pointer is made to indicate on a scale the space between the ship and the object responsible for the echo. Tests under service conditions have proved that wind and waves appear to have little effect one way or another on the range thus recorded. By the use of the instrument it was possible in from 3 to 5 seconds to pick up land 1,700 to 2,700 feet away; a pier about 2,500 feet removed, in a little more than 4 seconds; and a 563-ton vessel from 1,350 to 2,160 feet distant was located regardless of its position in relation to the craft equipped with the sonic detector in from 2½ to 4 seconds. As boats are required to travel slowly in thick weather, the interval between blasts is said to be sufficient to prevent a collision provided prompt action be taken the moment the warning echo is received.

This method of determining distance is a variation of a system that is now in use in a number of United States lighthouses to give ships within range their bearings in foggy weather.

Under the name of "Korodless", the Hazard Wire Rope Company of Wilkes-Barre, Pa., has put on the market a wire rope made of chrome-nickel stainless steel.



Leak-proof couplings are a vital part of this 18-inch pipe line which furnishes compressed air at 90 pounds pressure to one of the large mines in the Butte area.

Guarding Against Leaky Pipe-Line Joints

THE pipe line is an important and growing agency of transportation in the modern scheme of things. Without pipe we should want for water- and gas-distribution systems; the application of steam and compressed-air power would not have reached its present effective state; and we might conceivably still be in the town-pump era of civilization.

Extensive networks of pipe lines today convey crude oil, gasoline, and natural gas great distances. Buried underground, they function without noise or confusion, and only at comparatively rare intervals do they require digging up for repairs or replacement.

Man first hollowed out logs to serve as pipe. Later, with the knowledge of metal working at his command, he adapted wrought iron, cast iron, steel, and brass to his needs. Nowadays, pipe is specified for each particular service, experience having taught us which type is best suited for any one of the manifold purposes which pipe is called upon to serve.

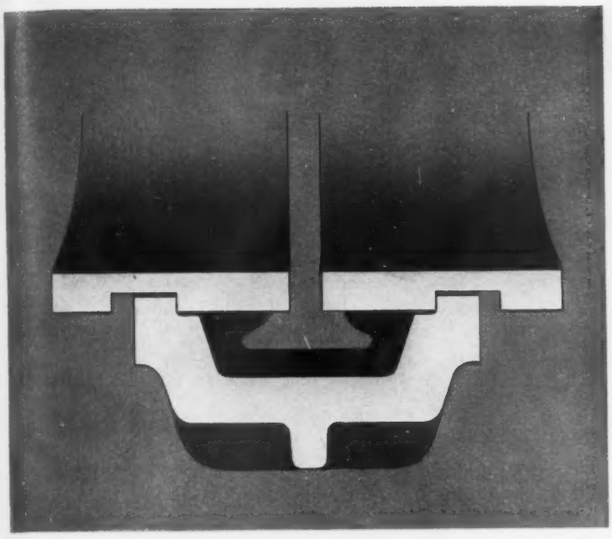
With the development of metal pipe, there arose a need for adequate joints or couplings in order to fabricate a continuous, integral line from a series of individual lengths. Threading of the ends of abutting lengths and screwing one within the other, or screwing a common band around the ends of each section, served the required purpose for many years.

With the increase of pressures within pipe lines, the adoption of pipe for transporting crude oil great distances, and the extension of natural-gas systems to the point where they now stretch a third of the way across the continent, it became necessary to provide a more suitable form of coupling.

An adequate coupling must be capable not only of withstanding high pressures but also of taking care of the alternate expansion and contraction to which pipe lines are subject with changes in temperature. In other words, to be serviceable, a coupling must have both strength and flexibility. Then, too, pipe lines are usually laid in shallow trenches and follow in general the configuration of the surface, which requires that they must accommodate themselves to numerous bends and flexures. The coupling becomes an integral part of the pipe line and it, in turn, must resist distortion without losing its essential capability of preventing leaks.

Among the patented couplings which have proved effective for this severe service is the Victaulic flexible leakproof coupling which is manufactured by the Victaulic Company of America, 26 Broadway, New York. Although it was placed on the market as recently as 1925, this coupling has assumed a position of such favor that more than 1,000,000 units, ranging in size from ¾ inch to 60 inches, have been put in use. These couplings have been applied successfully to pipe lines carrying a wide variety of liquids, including crude oil and several of its by-products, natural and manufactured gas, water, compressed air, chemicals, sewage, and even molasses.

This coupling consists of a self-sealing



A sectional assembly view which shows how the inner rubber gasket is held in place by the metal housing which rests in grooves in the adjoining pipe ends.

annular gasket of rubber which has a cross section roughly similar to the letter C, laid on its face with the points downward, and each point resting on one of the two adjacent pipe ends. This gasket is held in place by a metal housing which extends around it and which is tightened by means of two or more bolts. The feet of the housing rest in grooved channels running around the pipe ends. This gives them a firm grip upon their respective pipe lengths and prevents the pulling apart of the line even under relatively great stress. The housing serves to tighten the gasket down against the metal in such manner as to form a leak-tight joint which at the same time permits of nominal angular deflection and allows for contraction and expansion of the pipe through a wide range of temperature change. One of the accompanying illustrations shows a cross section of a coupling in position on grooved pipe ends.

Couplings of this type have successfully met service demands throughout a wide field of piping conditions, which have varied all the way from the intricate problems encountered aboard large steamships to the difficulties faced in laying a pipe line through the jungles of South America with only native unskilled labor.

The salvage value of such couplings is one of their noteworthy features. It is claimed for them that they can readily be dismantled from a pipe line, whereupon they become available in their entirety for use elsewhere. The pipe on which they were used is likewise unhurt and can be utilized again.

Several typical installations of this form of coupling are illustrated. Perhaps a brief account of a few instances where these couplings have solved the problems presented will serve to round out the picture of their great utility. Sometime ago the engineers in charge were confronted with the necessity of providing an adequate water supply for the Naval Ammunition Depot at Hawthorne, Nev. The source of supply was at a considerable distance, and the intervening country was one of tortuous, rocky canyons, shifting hillsides, and crazy land contours. Temperatures commonly varied every 24 hours from great heat at midday to chilling cold at night. Cursory consideration of the limiting conditions indicated that a considerable sum would have to be spent to blast rock, to provide anchorages for the pipe line, and to provide special bends and expansion joints. Further investigation revealed, however, that the Victaulic coupling incorporated the essential qualities to overcome these obstacles. The need for expansion joints and bends was eliminated, anchorages became unnecessary, and obstructions could be by-passed. The pipe was assembled on top of the ground and coupled as it fell without regard to surface contours. The line was completed in short time, and with economy, and was found upon test to be perfectly tight and leakproof.

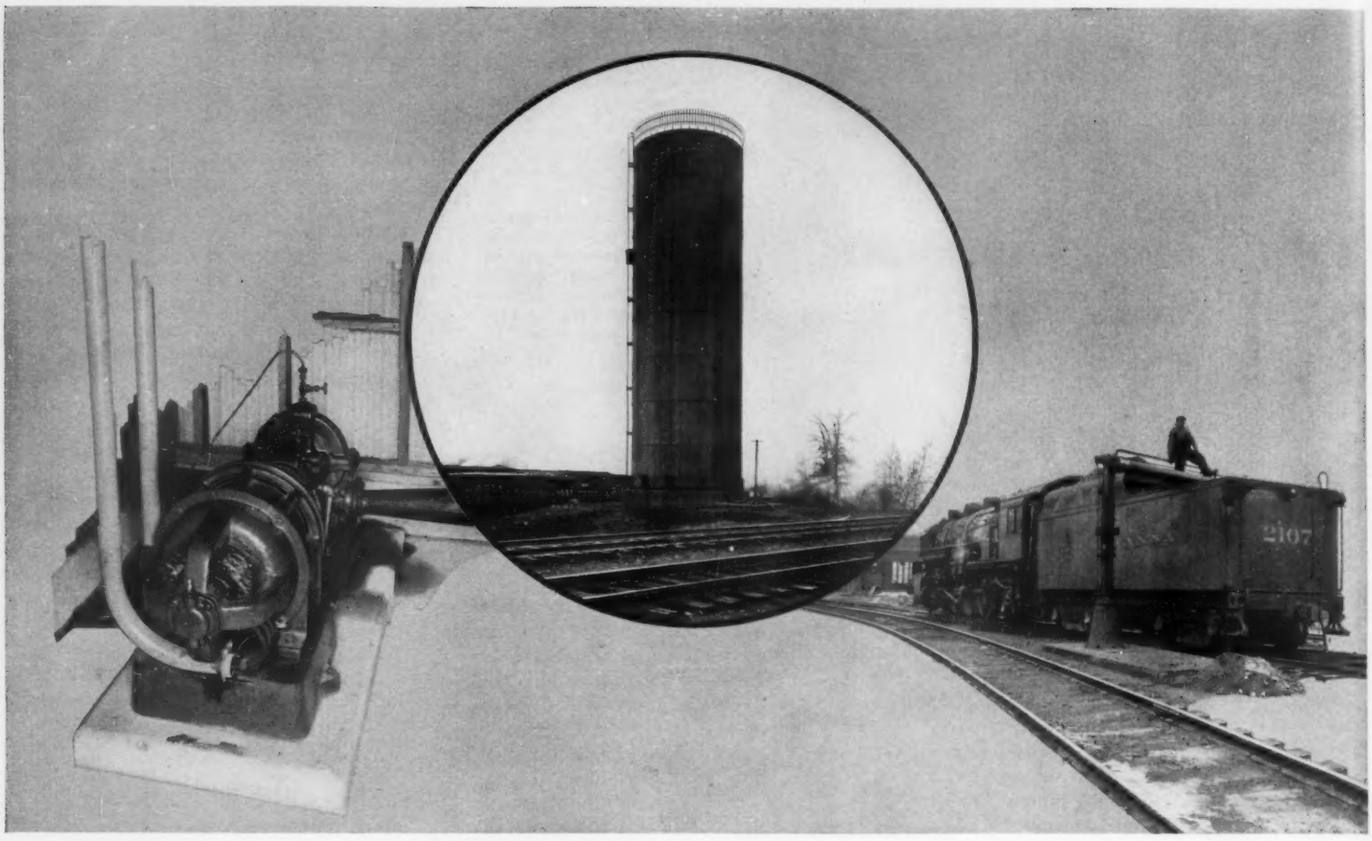
A water line serving the city of Jerusalem and equipped with Victaulic couplings withstood an earthquake a few years ago. When practically all other piping services were broken and useless, this vital artery remained tight, although badly shaken and shifted. Its continuation in service at such a time undoubtedly saved the city from famine and pestilence.

Victaulic-coupled lines have been widely adopted for compressed-air and water services in metal mines. The Frood mine of the International Nickel Company uses this type of coupling for such purposes. At the West Colusa Mine of the Anaconda Copper Mining Company at Butte, Mont., there is an 18-inch surface air line which remains tight and serviceable although it is exposed alike to the snow and cold of winter and to the hot rays of the summer sun. The Tennessee Copper Company uses Victaulic couplings on pipe lines in all its properties. It is reported that since the air lines were thus equipped it has been possible to shut down one compressor entirely and to operate a second unit on part time only.

With the rise to general use of these couplings, all pipe mills now stock pipe with ends grooved for their application; and manufacturers of pipe fittings produce a complete line of tools to facilitate speedy and economical field installations.

Compressed air equivalent to 48,000 kw. is now supplied annually to the mining industry of South Africa by the Victoria Falls & Transvaal Power Company. This company has lately completed another central compressor plant at Canada Dam to meet the increasing demand for this form of energy. The new station will add considerably to the present output.

The water line which serves the United States Naval Ammunition Depot at Hawthorne, Nev.



At the Port Morris yard of the Delaware, Lackawanna & Western Railroad. From left to right—Cameron No. 3 LV centrifugal pump that serves the 140,000-gallon standpipe. Locomotive taking on water before getting underway.

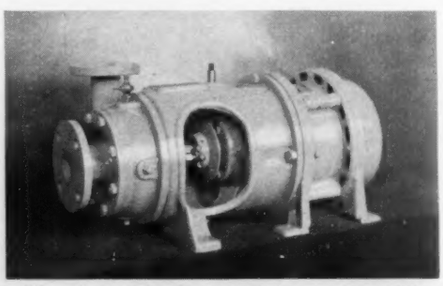
Slaking the Thirst of the Iron Horse

A PROSAIC but vital part of railroading is that of supplying water to the locomotives for the purpose of raising steam. It is easily conceivable that failure of the water supply at an important point in the line might interfere with traffic if it did not interrupt service for a time throughout the entire system.

Port Morris, N. J., on the Delaware, Lackawanna & Western Railroad, is a typical example of a railroad watering station. Practically all through freights to and from the terminus at Hoboken, N. J., take on water there. In addition, it is a freight-classification point, and a number of yard locomotives fill their tanks there several times a day. On an average, 60 locomotives take on substantially 400,000 gallons of water every 24 hours at this station.

The Musconetcong River, which is close at hand, supplies good soft water which does not have to be treated. The storage facilities consist of a steel standpipe, holding 140,000 gallons, and a concrete reservoir of equal capacity. A simple timber and screen roof protects the reservoir from dirt and debris. The reservoir is on higher ground than the standpipe and is connected to the latter. Water is pumped into the tank, and when a certain level is reached the reservoir begins to fill—the water flowing to various outlet points about the yard under a head corresponding to the height of water in the standpipe.

Until of late the water was pumped by a vertical, triplex piston pump. This was driven through a clutch by either one of duplicate single-cylinder, vertical engines. These units had to be started by hand, and required supervision 24 hours a day. Three men working in 8-hour shifts constituted the necessary crew.



The Cameron Motorpump, a compact, efficient, small pumping unit which is being adopted by many railroads for water-supply service and for numerous miscellaneous uses around shops and yards.

Recently, a single-stage Cameron centrifugal pump, driven by a 30-hp. motor, has been installed to replace the older equipment. This unit is equipped with an automatic start-and-stop switch actuated by a 9-foot rise and fall of the water level in the standpipe. This reduces the supervision to a mere matter of inspection and of keeping the pump lubricated. Only one man is now assigned to the work of taking care of the equipment. The pump house is a small frame shed covered with corrugated iron. Besides the pump and the switch boxes it contains a steel locker and a small stove. The intake for the pump is just outside of this building.

Ordinarily, there is little romance in filling a locomotive with water. However, water costs money, and improvements in methods of handling it are therefore important, even if unromantic.

Panels of interlocking steel flooring ready for load tests at the Belmont Iron Works.

INTERLOCKING STRUCTURAL STEEL FOR FLOORS

A NEW type of interlocking steel flooring that can be fabricated and erected by the contractor at the same time he is doing similar work on the primary structural-steel frame of a building, bridge, etc., has been developed and put on the market by the Belmont Iron Works. The floor is made of solid structural-steel members, with fillets and straight edges, that are suitably tied together. The troughs formed by the flanges are filled, depending upon service conditions, with fireproof materials such as concrete, gypsum, mastic, and the like; and they also serve as convenient ducts for the laying of piping, wiring, etc.

Belmont structural-steel flooring can be fabricated either in the shop or in the field in any desired length and in any number of units. According to the manufacturer, the flooring is not subject to buckling, warping, and bending, and it gives great stiffness because the interlocking flanges act as horizontal girders. This also tends to distribute the wind stress uniformly to all building columns. As deflection is reduced to a minimum, supporting beams can be spaced farther apart than has heretofore been the practice. The construction provides greater carrying capacity per square foot and, therefore, effects a considerable saving in the total dead weight of the floor as well as of the supporting columns. The new type of flooring is suitable for multiple-story buildings of any kind, but more especially for heavy duty in lofts, warehouses, factories, and power houses. It can also be used to advantage in the construction of bridges, roofs, large doors, and, with modifications, freight cars.

NEW STYLE BUILDING MATERIAL FOR RESIDENCES

SOMETHING quite revolutionary in building materials for private dwellings is being advocated by the Ferro Enamel Corporation of Cleveland, Ohio, which is putting up in that city an 8-room house to be of porcelain enamel and steel throughout. That this use of porcelain enamel and steel for architectural purposes is practicable has been demonstrated by the White Castle Company, which is said to have erected the first structure of this type in Wichita, Kans. The White Castle Company operates a chain of eating houses in some of the large cities of the West, and these restaurants have been built of porcelain enamel and steel under patents controlled by that company. Some of these structures have been standing for two years and more, and in that time have proved to be weatherproof, fireproof, almost soundproof, and to require little in the way of maintenance.

The residence that is now being constructed in Cleveland will have exterior walls of buff-colored, matte-glaze porcelain. This material is being furnished by the Louisville Enameled Products Company of Louisville, Ky., and is in the form of shallow, rectangular panels backed with cellular or fibrous insulating board. These panels are firmly secured by bolts and battens to a frame of fabricated sheet-metal studs, 4 inches deep and spaced on 16- to 36-inch centers. The battens are of porcelain and serve to seal the joints and to make them proof against the weather. A special kind of ship-lap is used for the horizontal joints, which are also weatherproof. The walls are well insulated with mineral wool or other suitable material; and although they have a total thickness of but 6 inches they are claimed to be far more effective than the average 12-inch masonry wall in keeping out both heat and cold. The interior may be finished in porcelain or plaster.

ROADBUILDER SUBSTITUTES FILL FOR PEAT BY BLASTING

HIGHWAY contractors were recently much interested in a road-grading job in Illinois that involved substituting 72,000 cubic yards of fill for 35,000 cubic yards of peat. The contract covered a 6½-mile stretch of state highway between Rosencrans and Antioch, and specified the removal of 91,000 cubic yards of material. Of this, 56,000 cubic yards was handled by a special elevating grader and side-dump wagons, all of which were pulled by tractors. The disposal of the peat was another matter.

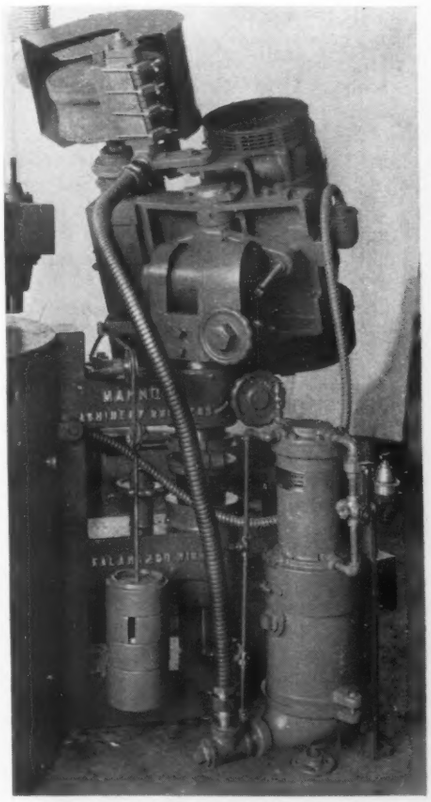
The section to be cleared had a width of 40 feet at the base and an upward slope of 2 in 1. Where the peat was shallow, no difficulty was encountered in excavating it by dragline; but where the deposit reached depth, as much as 30 feet in places, blasting was resorted to—the removal of the peat and the placing of the fill being done in one operation. The method of procedure was as follows: First, fill to the required depth was spread on top of the peat. Next, holes were put down through the fill and the peat and loaded with dynamite. When this was set off, the pressure of the resulting gases was sufficient to compact the yielding peat and to force it to either side, permitting the superposed fill to fall into the opening thus cleared.

AIR-OPERATED PASTE FEEDER FOR POLISHING MACHINES

THE work of mechanically polishing and buffing surfaces has been further simplified by the development of an attachment that applies the paste or compound automatically to full-automatic, semi-automatic, and hand polishing lathes. The feeder was designed by the Hammond Machinery Builders for use with its own equipment, but it can readily be attached to other makes of lathes now in service.

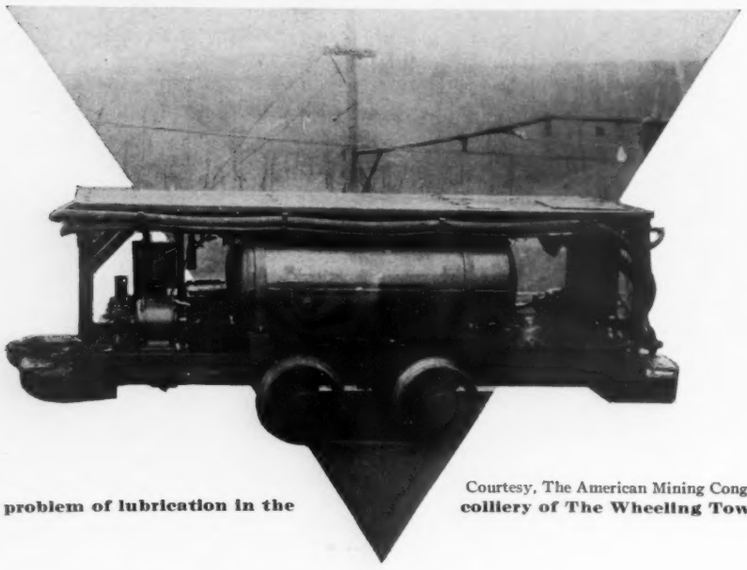
The feeder is air-operated, and delivers the paste through nozzles directly to the polishing and buffing wheel. The centrifugal force of the wheel deposits the compound on a collector pad that is clamped to the end of the nozzle. This pad presses against the polishing wheel and serves further to distribute the paste. The amount required for a given piece of work can be fed to the wheel either constantly or intermittently, as may be desired. For the latter purpose the machine is provided with hand or foot control, whichever may be preferred.

The nozzle, with its adjustable discharge spout, comes in sections, and can be built up to cover any width of wheel; and it can also be set to meet the needs of flat, irregular, or curved contours—a flexible hose permitting a wide adjustment of contact points. Different kinds of suitable pastes, conveniently packed in drums, can be purchased for use with this new attachment. Needless to remark, a thoroughly practicable feeder of this description should make for considerable savings in both time and material.



How the pneumatic feeder is attached to a buffing machine. The paste is in the pressure container at the right.

Electro-Pneumatic Lubricating Machine For Mechanical Loaders



The machine that solved the problem of lubrication in the colliery of The Wheeling Township Coal Mining Company.

Courtesy, The American Mining Congress Journal

PROPER lubrication of mechanical loading machines in mines, especially when operating in multiple shifts, has not been as simple a problem as it might seem on the face of it. As the work has ordinarily been done it has been wasteful not only of time but of oil and grease, and managements have therefore looked about them for more suitable means and methods. The experiences of one colliery in this particular should prove of interest because, after considerable experimenting, it has succeeded in devising a portable lubricator that is said to operate well and quickly and with a marked reduction in oil and grease consumption, as compared with previous practices.

A little more than three years ago, The Wheeling Township Coal Mining Company introduced mechanical loading throughout its workings. At that time each loader was lubricated at the beginning of a shift by its operator and a helper, and it took them half an hour, or 6 per cent of their 8-hour day, to do the oiling. This was unsatisfactory for a number of reasons, and not the least of these was that the men in charge worked on a tonnage basis. As the company's efficiency engineer, A. J. Ruffini, has put it: "The method was very slow and wasteful, and in many cases a bad job of lubrication was done, resulting in burnt bearings, long delays, and high maintenance costs.

"By the hand method, a barrel of grease and a barrel of oil were supplied to each working section. This meant eighteen barrels of oil and eighteen barrels of grease distributed throughout the working area. The operator and the helper were provided with a hand-pressure gun and two 5-gallon oil cans—the operator with the aid of the gun lubricating all the bearings and the helper filling the gear cases. But even with the utmost care, considerable oil and grease was wasted not only in lubricating the loader but in filling the hand gun and the cans."

To overcome these handicaps, the company decided to have the oiling done outside of the regular working hours and by a gang responsible to the mine's chief mechanic. This system was put in effect, but was abandoned at the end of six months. While an improvement as far as the lubricating itself went, it did not do away with the wasteful hand-pressure gun and oil cans. Consumption of grease and oil continued to be high, and stuck bearings were still a source of trouble because it was impossible with the available equipment to flush out the bearings.

Then it was that The Wheeling Township Coal Mining Company began to look about for a semi-automatic filling and lubricating machine. Nothing of the kind was apparently to be had, so the management proceeded to design one. After much planning, a portable unit was built that met all requirements. It consists in the main of an electrically driven gun, of two tanks with a capacity of 78 gallons each, and of an air compressor capable of maintaining a pressure of 80 pounds on the oil and grease in the tanks all the while the gun is in use. These, together with two lengths of high-pressure hose, are mounted on a 3x12-foot standard mine-car bed which, in turn, is mounted on a 42-inch-gage roller-bearing truck.

A filling station has been provided near the workings where the lubricants are transferred from the drums, placed for the purpose on racks, to their respective tanks. To do this it is only necessary to start the compressor after having attached the air line to a ¾-inch opening in the drum and the oil or grease hose, as the case may be, to another 2-inch opening—the pressure forcing the contents of the drum into the tank without loss. It takes two men 1½ hours to get the two lubricating machines now in use at the colliery ready for service. Each machine is in charge of two men.

At present the mine is operating on a schedule of two 8-hour shifts with an interval between of 3½ hours. As soon as a regular shift comes off, the lubricating crew starts on its round. The men hook their machine to a gathering motor and take it from one section of the mine to another until all the mechanical loaders assigned to them have been taken care of—the capacity of the tanks being such that it is not necessary to return to the filling station for more oil and grease.

Each loader has 32 Alemite connections, seven gear cases, one hydraulic tank, and two armature bearing cups, and all these, with the exception of the latter, have to be lubricated every shift. The armature bearing cups are inspected each trip but filled only every other shift. Performance records show that this work can now be done in 24.8 minutes, including the time required to get the machine to the point of use. Besides cutting in half the time formerly needed to lubricate a loader, wastage has been eliminated; and the electric gun, by building up a pressure of 3,300 pounds, makes it possible to flush out the bearings.

BUREAU OF STANDARDS STUDIES QUENCHING SOLUTIONS

STEEL is an alloy capable of developing properties covering a wide range of strength, hardness, and ductility. It is because of this that steel plays so important a part in modern life and industry. One of the principal duties of the metallurgist is to determine how to treat any given steel so that it will have the qualities needed in some particular service. The more common steels are made soft by cooling slowly from temperatures approximating a "red heat", and are hardened by cooling quickly.

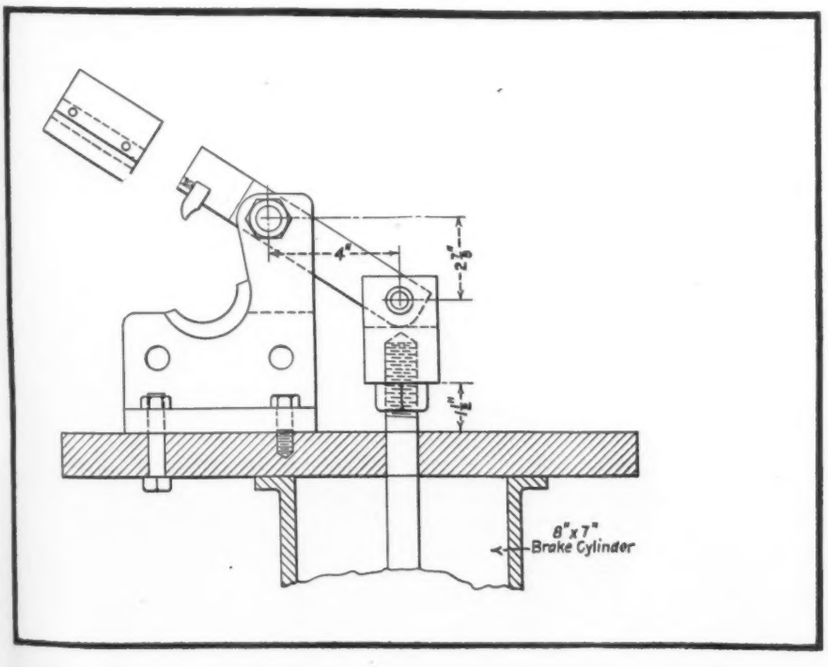
Quenching—that is, cooling rapidly from a red heat by plunging metal into water or oil, is thus a fundamental process in heat treatments employed to enhance certain inherent properties of steel. The precise structure produced through quenching is controlled by the speed at which the steel cools during the operation. Water and oil are the most commonly used quenching media, and of the two water is the quicker acting. A steel quenched in water is generally harder than one quenched in oil. Occasionally a water-quenched steel is too hard for the most satisfactory service. In such a case it is frequently necessary to resort to a tempering treatment, which consists of reheating the steel after quenching.

A product equivalent to or possibly better than the run of quenched and tempered steel would often be possible if quenching solutions were available possessing characteristic cooling rates between those of water and oil. Recently, the United States Bureau of Standards made a study of aqueous solutions of ethylene glycol, glycerine, and sodium silicate to determine whether any of them, if suitable for quenching, had characteristic cooling rates in this intermediate range. It was found that the solutions of glycol and of glycerine did not give results which were readily reproducible. However, solutions of several concentrations of sodium silicate not only proved to have such quenching rates but gave very consistent results. Some of these sodium-silicate solutions must be treated with small additions of caustic soda so they will not undergo changes when allowed to stand for several months.

CUTTING FITTINGS FROM SCRAPPED HOSE BY MACHINE

A SPECIAL cutting machine has been devised for removing fittings from worn-out steam and air hose. The apparatus illustrated, designed for railroad-shop use, can be put together readily and will do the work quickly. The principal features of the machine, which is pneumatically operated, are a brake cylinder, a cutter, and a stand for the hose. The cylinder is secured to the underside of the work bench on which the stand is bolted.

The stand is made up of a right- and a left-hand section, 5⅞ inches long and 7¼ inches high, riveted to a central block 5⅞ inches long, 3⅝ inches high, and 1½ inches thick. This block and its associate side pieces are machined with a recess to hold the hose during cutting. Two blades are provided: one for steam hose and one for air hose. These knives are ½ inch thick and 3 inches long, varying only in width, which is 1⅛ inches for the steam hose and 1 5/16 inches for the air hose. They are inserted, as required, in the cutting lever fastened to the upper end of the brake-cylinder piston rod and pivoted between the uprights of the stand. When cutting air hose it is necessary to put a 1 1/16-inch bushing in the recess so that the hose will be held firmly when the blade is brought in contact with it upon the application of pressure. The knife slits the hose through to the stem of the fitting, after which the fitting can be removed easily.



Principal features of the air-operated hose-cutting machine.

Courtesy, The Colliery Guardian

The work of lining tunnels with concrete blocks is facilitated by this new portable crane.

SPECIAL CRANE FOR TUNNEL WORK

SOMETHING compact and portable in cranes has been produced by a German manufacturer especially for the handling of heavy precast concrete blocks within tunnels or other confined areas. The crane proper is mounted on a wheeled underframe and can be set up quickly. It consists of a vertical column carrying a winch and a horizontal jib provided with an air cylinder—the cylinder with its piston forming an extensible lever arm. Both the column and the cylinder pivot about their respective axes, and can be securely held in any position. Fastened to the free ends of the cylinder and to the piston are sheaves over which the rope is led to the winch drum. The operation of the crane is effected by a compressed-air motor.

As our illustration shows, the block to be laid is grabbed by a hook, suspended from the rope, and hoisted by the winch to just below the sheave. The crane is then swung about its vertical axis either to the right or to the left, depending upon where the block is to go. By taking in the rope a little more the load is raised still farther—the cylinder in the meanwhile being rotated about its horizontal axis. When in position for laying, the piston is forced out just far enough by the application of compressed air to spot the block, which is then lowered into place by slackening the line. The crane has a maximum lifting capacity of 330 pounds; and by its use unskilled labor can, it is said, lay a block in a minute. The material required for filling in is also handled by the crane in self-opening metal boxes.

To span the last gap separating Copenhagen from the mainland, the Danish authorities have authorized the construction of a bridge six miles long between the islands of Fuenen and Zealand.

ELECTRIC SLUSHER HOISTS OF INCREASED CAPACITIES

ELECTRIC double-drum hoists have proved remarkably effective and economical machines for slushing and dragline work in metal mines, coal mines, and various industrial plants. They are easy to move and to set up anywhere, they occupy but a small amount of space, and they can be installed and operated in restricted places. The adoption of these hoists in metal mines has not only reduced costs of loading ore but it has in some cases led to the development of simpler methods of mining. Similar advantages accompany the use of these hoists in coal mines. They also fit in well for moving and piling a wide variety of products in commercial and industrial fields.

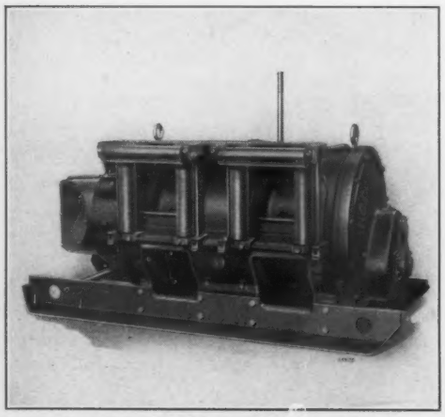
To meet the need for hoists of a wide range of capacities, the Ingersoll-Rand Company has recently added four new sizes to its line of double-drum electrically operated units. These are the Size 207, of 7½ hp., the Size 210, of 10 hp., the Size 225, of 25 hp., and the Size 235, of 35 hp. These additions increase the available line to six sizes, as 15- and 20-hp. units have been made for some time.

The new sizes follow essentially the same construction as the earlier units, and embody all the features that have made them popular and dependable machines in the several fields of service to which they are adaptable. Among these features, the following may be cited as distinctive: fully enclosed construction which protects drums, clutch, and brake; brake lock; 2-clutch, balanced-drum drive with single-lever safety control; enclosed gear chamber with helical silent-type gears operating in a bath of oil; foot-controlled brakes; adjustable, case-hardened cable rollers mounted on Timken roller bearings; steel skid mountings; and accessible external motor.

When equipped with standard alternating-current, 220-440-volt, 3-phase, 60-cycle or direct-current, 230-250-volt motors, Size 207 will give 2,000 pounds of rope pull at 125 feet per minute, and Size 210 will give the same rope pull at 165 feet per minute. The cable capacity of both drums is 475 feet of ⅜-inch or 275 feet of ½-inch cable for both sizes of hoists.

When equipped with standard alternating-current, 220-440-volt, 3-phase, 60-cycle motors, Size 225 will give 2,800 pounds rope pull at 285 feet per minute, and Size 235 will give 4,000 pounds rope pull at 285 feet per minute. Either size can be furnished with direct-current motors when desired. Each drum has a capacity of 1,000 feet of ½-inch or 650 feet of ⅝-inch cable. For mounting on car-loading slides, these hoists can be furnished with both clutch and brake end control.

Additional information may be secured by writing to Ingersoll-Rand Company, 11 Broadway, New York City.



Size 225 electric, double-drum hoist for slushing and dragline work.

CONSERVATION IN THE DEPARTMENT OF THE INTERIOR, by Ray Lyman Wilbur and William Atherton DuPuy. A volume of 253 pages and 200 illustrations, published by the Government Printing Office. Available from the Superintendent of Documents, Washington, D. C. Price, $1.00.

THIS book discusses vital Government problems which concern the average citizen. In a sense it is an accounting of the stewardship of Secretary Wilbur, and is designed to acquaint all of us with the outstanding phases of the many important functions which the Secretary of the Interior performs for us. It delves into the riddle of over-production of petroleum, discusses the Indian problem, tells of the development of a suitable form of government for Alaska, and gives enlightening information on the National Park System. Among the many interesting facts which it divulges is the knowledge that Uncle Sam still owns land which aggregates an area as large as Texas. The book suggests a new set-up for handling these lands: their delivery to and administration by the states in which they lie. The writing is popular in style and designed to appeal to the person who seeks to gain a clear understanding of some of the problems of the people as a whole in the field of conservation.

THE ROEBLINGS, by Hamilton Schuyler. An illustrated volume of 445 pages, published by the Princeton University Press, Princeton, N. J. Price, $5.00.

THIS is the absorbing story of three generations of bridge builders, engineers, and industrialists. It starts with an account of the life of John Augustus Roebling and traces up to the present time the interesting events that have transpired under the guidance of Roebling brains and hands. We are told how the first Roebling left his native Germany for America because he realized that here in this land of political freedom he could better achieve his dream of building great bridges. How well he succeeded the world knows. He erected his own monument in the form of steel webs across the waterways around New York City, Pittsburgh, and in other sections of the East. Mr. Roebling got into the wire-rope business because of the demand for this material to haul rail cars up grades of the portage railways used in the vicinity of Saxonburg, Pa., the colony he founded upon coming to America. His first manufacturing plant was on his farm there. Later he moved the works to Trenton, N. J., and formed the nucleus for the present great industrial enterprise.

How his son, Col. Washington A. Roebling, took up the father's work and carried it on, and how still other members of the illustrious family are today maintaining traditions, are told by Mr. Schuyler in an entertaining manner. The book contains a hitherto unpublished manuscript by Col. Washington A. Roebling describing the Roebling activities at Trenton as they were in 1919, and it ends with a chapter on the new George Washington Bridge across the Hudson River by C. C. Sunderland, chief bridge engineer of the Roebling Company, who was in charge of the cable construction of this latest Roebling-cabled span.

Mr. Schuyler had full access to the Roebling family records as a source book for his material, but he had a free hand in developing the story. The result is a piece of writing that anyone at all interested in engineering and industrial achievement will thoroughly enjoy.

Air Starting Units for Internal Combustion Engines is the title of an 8-page illustrated leaflet, Form 1897, that has recently been issued by the Ingersoll-Rand Company, 11 Broadway, New York City. The factors that enter into the selection of suitable machines of this class are briefly discussed, and electric-, gasoline-, and belt-driven compressors of the company's make are described and illustrated. Diagrammatic sketches and tables of dimensions for each unit are also included to assist engineers and architects in laying out plants. One page is devoted to starting-air tanks; and a formula is given for determining the time required to pump up a tank to various pressures.

The Easton Car & Construction Company, Easton, Pa., maker of cars for all industrial purposes, has available for distribution the following new bulletins: No. 3-B, Rocker Dump Quarry Car; No. 42, Granby Quarry Car; No. 28-A, Phoenix Quarry Car; No. 41-A, WonWay Quarry Car; and No. 40, Easton Quarry Truck Bodies.